March 25, 1947. C. H. ZIMMERMAN 2,417,896

HELICOPTER FLYING APPARATUS

Filed Aug. 10, 1943 4 Sheets-Sheet 1

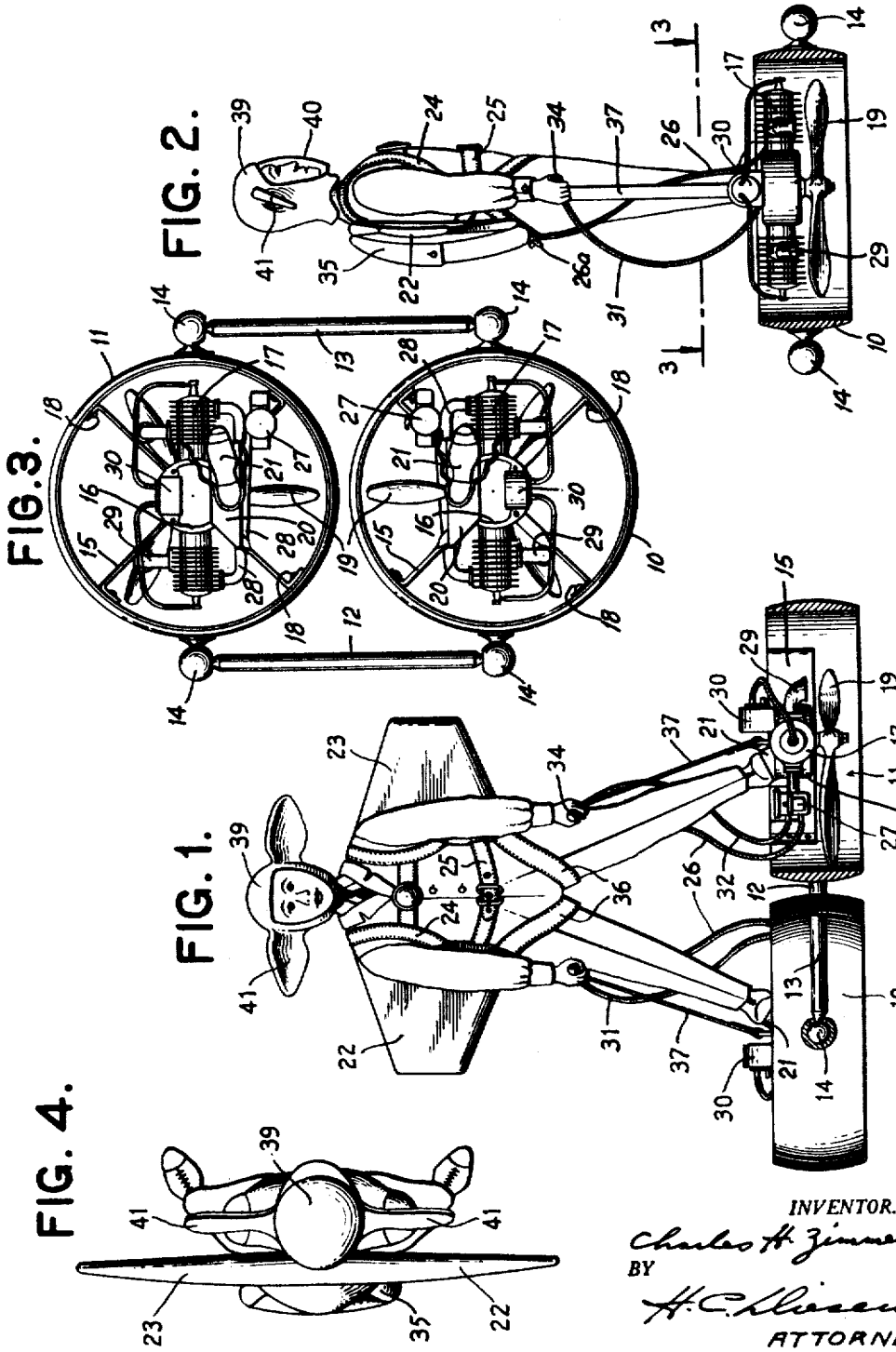

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

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HELICOPTER FLYING APPARATUS

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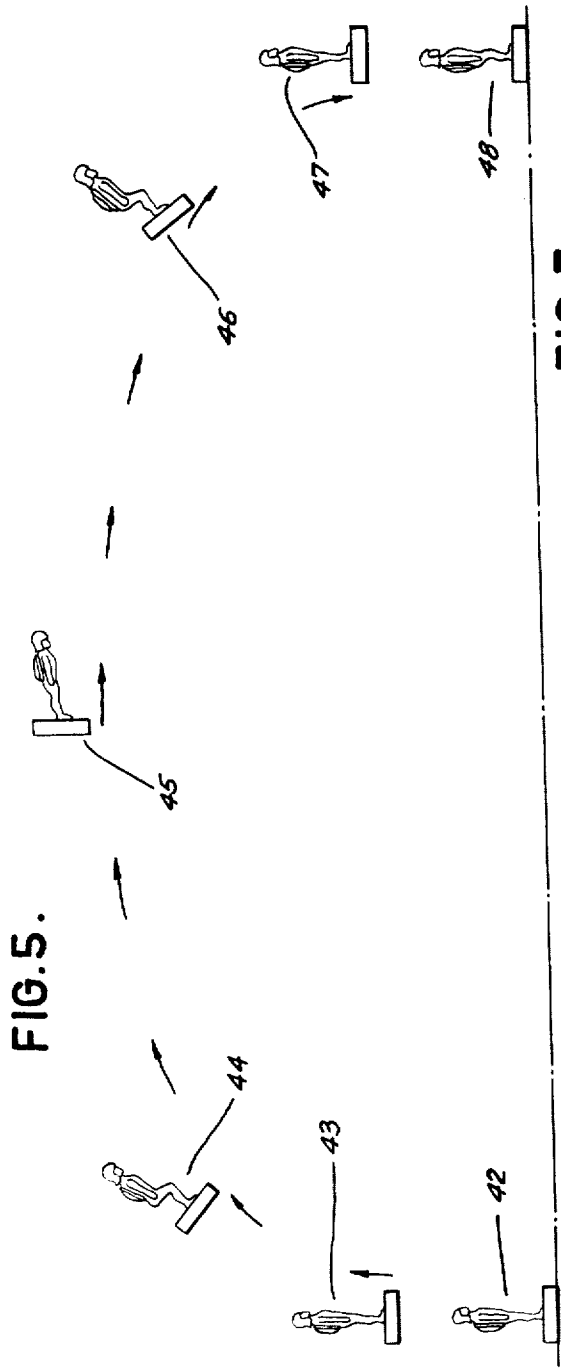

FIG. 5.

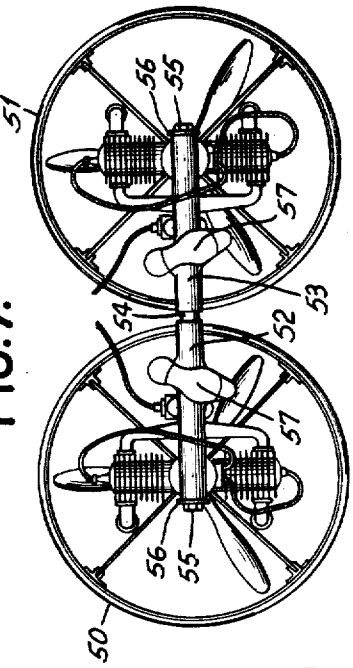

FIG. 7.

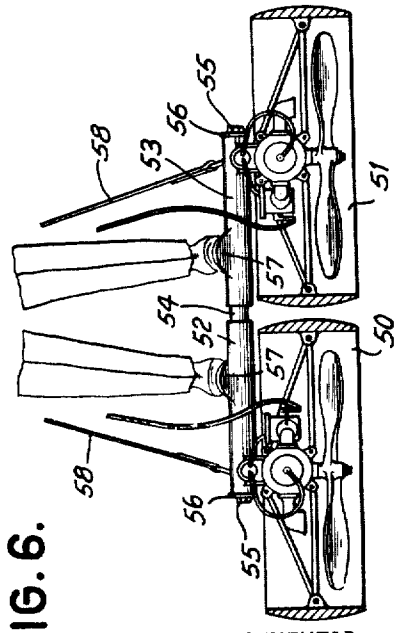

FIG. 6.

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HELICOPTER FLYING APPARATUS

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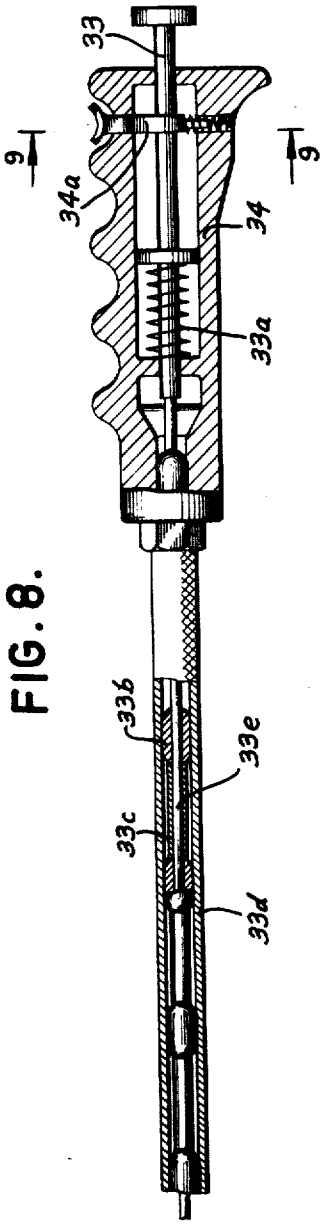

FIG. 8.

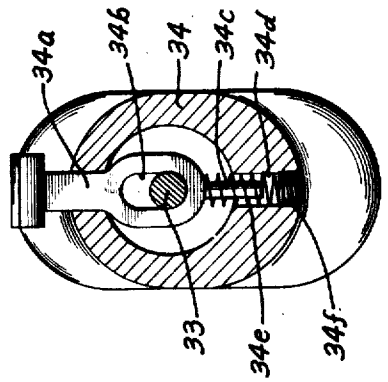

FIG. 9.

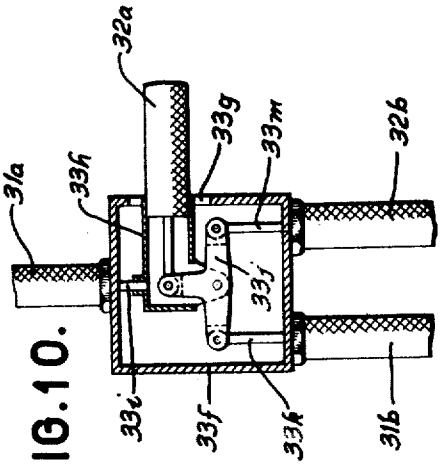

FIG. 10.

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HELICOPTER FLYING APPARATUS

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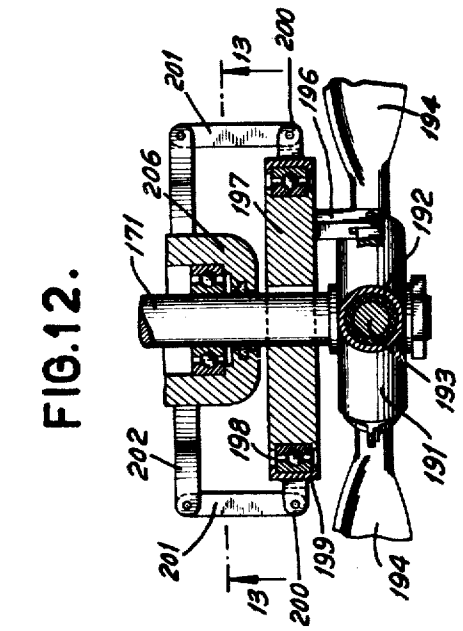

FIG.12.

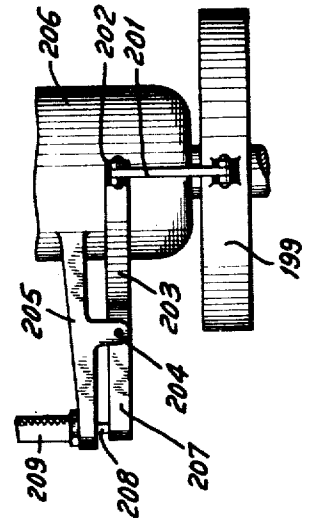

FIG.14.

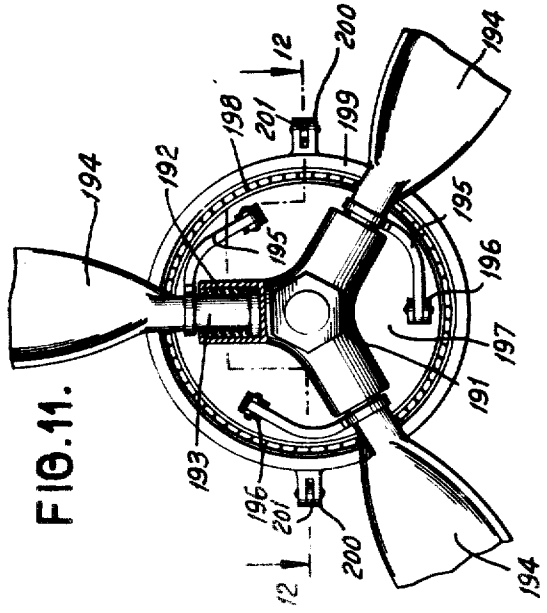

FIG.11.

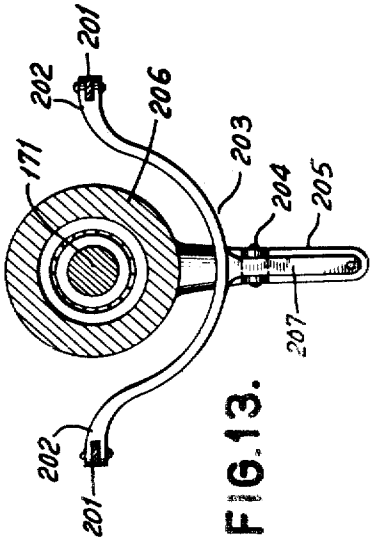

FIG.13.

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UNITED STATES PATENT OFFICE

2,417,896

HELICOPTER FLYING APPARATUS

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Application August 10, 1943, Serial No. 498,075

16 Claims. (Cl. 244—17)

1

This invention relates to a novel method of and apparatus for propelling a person through the air. The apparatus is, more particularly, of a type arranged to be worn by or applied to the person using the same, as distinguished from a vehicle, ship, machine or conveyance adapted to carry one or more persons.

An object of the invention has been to provide suitable motive power and suitable lifting and direction control surfaces or instrumentalities which may be, in effect, applied to or worn by a person desiring to be propelled through the air. In attaining this object, I have devised a power and propeller unit which, in the preferred form of the invention, comprises a pair of interconnected members which may be attached to the feet of the person to be propelled or on which such person may stand. This unit is of such construction that each of the interconnected members is under the control of one of the feet of the user, the two members being thus independently maneuverable to a certain extent, although they are, as indicated, connected together to maintain the same in properly spaced and assembled relation. The power unit is the major part of the equipment attached to or worn by the flyer and it may, if desired, be the only flying equipment employed so long as it embodies, in itself, certain air foil surfaces. Preferably, however, a number of accessory devices embodying lift-producing surfaces are utilized to facilitate flight, to assist in the control of the movements of the flyer, and to insure his safety.

Briefly, the invention contemplates the application of lifting and propelling forces to the feet of the flyer, the use of the apparatus being such that the flyer is first lifted vertically as he stands more or less erect on the power unit and after he has attained a suitable elevation he inclines his body forwardly in the direction he desires to travel. He may continue to rise for a while, along with the forward motion, and then gradually assume a substantially horizontal position as he travels toward the desired goal. Upon approaching the goal, the flyer may gradually reduce his forward motion and the lifting action of the power unit, in one or more of a variety of ways, and at the same time may swing his feet downwardly or flex his knees to assume firstly a sitting posture and then a substantially vertical position again after which he may gradually ease himself toward the ground. The take-off, flight and landing of the flyer is in many respects similar to the operation of a helicopter. A very limited space is sufficient for take-off and landing

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purposes. However, as distinguished from a helicopter, the propelling means applies a pushing force to the feet of the flyer rather than a pulling force from above and there is no integrated, steerable machine in which the flyer may sit, for example.

Other objects, features and advantages of the invention and its specific nature will appear from a detailed description of an illustrative form of apparatus and its mode of use which will now be given in conjunction with the accompanying drawings, in which:

Fig. 1 is a view partly in front elevation and partly in section, showing the improved flying apparatus attached to the flyer.

Fig. 2 is a view, largely in side elevation but partly in section, of the apparatus and the flyer shown in Fig. 1.

Fig. 3 is a plan view of the main portion of the flying apparatus, taken along the line 3—3 of Fig. 2.

Fig. 4 is a top plan view of the flyer, omitting, however, a showing of the apparatus attached to the flyer's feet.

Fig. 5 is a diagrammatic view illustrating the position of the flyer at various stages in the course of flight.

Fig. 6 is a vertical sectional view through a modified form of apparatus attached to the flyer's feet.

Fig. 7 is a top plan view of the modified construction of Fig. 6.

Fig. 8 is a detail view, largely in section, of one of the control means adapted to be grasped by the flyer.

Fig. 9 is an enlarged detail view, in section along the line 9—9 of Fig. 8, showing a releasable detent for the control means.

Fig. 10 is a detail view, partly in section, showing a modified form of connection between two manual controls which may be employed, if desired.

Fig. 11 is a bottom view of a portion of a variable pitch propeller which may be embodied in each of the Venturi rings.

Fig. 12 is a vertical, sectional view, along the line 12—12 of Fig. 11.

Fig. 13 is a detail view, in section along the line 13—13 of Fig. 12, showing a portion of the pitch varying means, and

Fig. 14 is a detail view, in side elevation, of the pitch varying means of Fig. 12.

Referring now particularly to Figs. 1 to 4 of the drawings, the preferred form of the invention comprises a pair of connected Venturi rings

10 and 11. These rings are held in properly spaced relation and against rotation about their axes by links or rods 12 and 13 which are attached to the outer surfaces of each of the rings at diametrically opposed points by means of swivel connections 14. These connections may be of any suitable mechanical construction enabling universal angling movements between the rods 12 and 13 and each of the Venturi rings. Thus, each of the rings may be rocked freely in all directions with relation to the other while maintaining substantially the same relative spacing between the rings. The outer and inner surfaces of the rings are preferably so formed and related that a longitudinal section through the wall of each ring is of proper air-foil configuration.

Within each of the Venturi rings there is mounted, by means of a spider frame 15 having a central supporting ring or cylinder 16, an engine or other suitable source of motive power 17. The arms of the spider 15 are suitably attached to the Venturi ring by means of rivets 18 or other suitable securing means. Engine 17 may be of any suitable construction, say, for example, a two-cylinder, four-cycle internal combustion engine of conventional type or it may be a power means of any other appropriate construction, capable of developing high power in relation to its weight. Preferably, each engine should be capable of developing about 40 H. P. and each should weigh only about 50 lbs. If desired, a more powerful engine may be utilized but substantially the indicated ratio of power to weight should be maintained. A gasoline turbine meeting these requirements may be employed in lieu of the reciprocating engine illustrated. The supporting ring or cylinder 16 carries appropriate bearings for a crank shaft connected with the pistons of the internal combustion engine. The crank shaft projects below the lower bearing and has secured thereto, or otherwise operatively connected therewith, a propeller 19 of appropriate construction. This propeller may either be of fixed pitch or variable pitch. The pitch may be subject to variation automatically, either partly or fully in known manner, or it may be under manual control. If the propeller is of the manually variable type, any known and suitable form of control system may be employed. One arrangement which may be used for this purpose is shown in Figs. 11 to 14, inclusive, and will be hereinafter described. By way of illustration, the propellers may be of the three-blade type and about 3 feet in diameter. Each is preferably provided with only a slight clearance from the inner surface of its Venturi ring.

At the top of each Venturi ring there is provided on a plate 20, preferably mounted on the spider 15 or the ring 16, a foot-supporting and retaining formation 21 on which the flyer may place one of his feet. The foot-support is preferably inclined at an appropriate angle, as indicated in Fig. 1, so that the flyer, assuming the stance indicated, may have flat surface engagement with the support without bending his ankle. This enables transverse rocking of the ring in either direction by proper flexing of the ankle. Moreover, it permits a straight pressure to be exerted by the flyer through his legs directly against the foot support and the arrangement is preferably such that the line of pressure so exerted by each leg will intersect the line extending through the axes of the front and rear ball joints 14 of the related Venturi ring. Assuming

that the rings are slightly more than 3 feet in diameter, so as to accommodate 3 foot propellers, the flyer's feet will need to be spread slightly less than 3 feet apart in assuming the stance indicated in Fig. 1. This is not an uncomfortable stance for a man of average height. The foot supports 21 may either be provided with suitable straps or other means for clamping the flyer's feet firmly thereto or, if desired, the foot supports may have permanently and firmly secured thereto boots or shoes of suitable construction and adapted to fit snugly and comfortably the feet of a particular flyer. In the latter case it will be understood that the apparatus constructed in accordance with the invention will be a personal device intended for use by a definite individual, much as a pair of skates having permanently connected shoes.

Gasoline or other fuel for the engine may be carried in a tank strapped to the back of the flyer. Preferably the tank will be formed as a pair of wings 22 and 23 of suitable construction, these being secured to the flyer by means of straps 24 over the flyer's shoulders and a strap 25 around the flyer's waist. The wings 22 and 23 may be formed as an integral unit or may be otherwise connected and should be properly shaped and so disposed as to provide or constitute air-foils which will have a definite supporting and lifting action as the wearer of the apparatus is in flight, in a manner to be more fully set forth hereinafter. A pair of outlets may be provided along the lower edges of the wings 22 and 23 and from these outlets flexible hose lines 26 may lead to carburetors 27 mounted upon the engines within the Venturi rings. A valve or pet-cock 26*a* may be provided in each of the hose lines 26, preferably at its point of connection with the tank structure, to cut off the supply of fuel when desired and to enable manual regulation of the supply. From the carburetor 27 in each Venturi ring the explosive air-fuel mixture may be led through a manifold 28 to the intake ports of the cylinders of the associated engine. Each cylinder may be provided with a short exhaust pipe 29, preferably arranged to direct the exhaust downwardly through the propeller 19. A magneto 30 may be employed for ignition purposes, although other suitable ignition means may be provided, if desired.

For the purpose of controlling the operation of the engines, a pair of flexible push-pull controls 31 and 32 of any suitable form, such as the Bowden wire type, may be provided. If desired, each of these controls may be connected with the valve operating means of one of the carburetors 27, as shown in Fig. 1, so that the speed of the propellers may be varied independently at all times. Thus, control 31 may regulate the speed of the engine in Venturi ring 10 and control 32 may regulate the speed of the engine in ring 11. By varying the speed of one engine in relation to the other, the movements of the flyer may be controlled, as will be explained more fully hereinafter.

The operation of the push-pull control members will be readily understood. A plunger 33, Fig. 8, normally urged outwardly from its supporting socket or hand grip 34 by means of a spring 33*a*, may be pressed inwardly against the action of the spring by the thumb or finger of the flyer. The inward movement of the plunger is transmitted through the series of push elements 33*b* and 33*c* within the flexible sheath or casing 33*d*, to the valve control means on the carburetor

so as to regulate the flow of the air-fuel mixture into the manifold 28. Outward movement of the plunger, either by the action of spring 33a or by the force exerted by the thumb or finger, will act through the flexible, inner pull cable 33e to shift the valve control means in the opposite direction. If desired, the plunger 33 may be provided at its outer end with a small ring, or a thimble-like socket, in lieu of the button shown, adapted to receive the thumb for movement of the plunger positively in both directions. Outward movement, however, may nevertheless be assisted by the spring 33a.

Control cables 31 and 32 should be of sufficient length to give the flyer full freedom of movement of his arms, for balancing purposes, while retaining the controls in his hands. Provisions of any suitable character may be made for attaching the controls to the uniform or flying suit of the flyer, or to one of the various straps about his body, whenever the flyer desires to use one or both hands for some other purpose or when he is traveling at uniform speed in horizontal flight. Thus, a clip of any appropriate form may be provided on each control, at or adjacent the hand grip, for ready attachment and detachment to and from one of the belts. A detent is preferably provided for retaining the plunger 33 of each control in any position in which it has been set. This detent may suitably be in the form of a small plate 34a slidably mounted in the hand grip 34 adjacent its outer end. The plate has an elongated slot 34b through which the plunger 33 passes and at its lower end it carries a pin 34c having a loose fit in a recess 34d in the wall of the handgrip. A spring 34e, within this recess, surrounds the pin 34c and, acting between an enlarged portion of the plate and a plug 34f which closes the lower end of recess 34d, serves to urge the plate upwardly, Fig. 9. The frictional engagement between the lower edge of the slot 34b and the under surface of the plunger 33 will serve to retain the latter in any adjusted position. In this connection it will be observed that the plate 34a will be rocked slightly by the acting of spring 33a, as permitted by the loose fit of the pin 34c in recees 34d, to bring about an effective binding action. When it is desired to release or re-adjust the plunger 33, the plate 34a may simply be pressed inwardly slightly by a finger or by the squeezing action of a portion of the hand in which the handgrip is held.

In Fig. 10, a portion of a modified control arrangement is shown in which the control held in one hand may simultaneously vary the speed of both engines while the control in the other hand may produce a differential action between the two engines. For this purpose the outer casing or sheath of the righthand control 31a may be connected with a small housing 33f while the casing of the lefthand control 32a may extend into this housing through an elongated opening 33g, which permits slight, relative up-and-down movement. A cap member 33h secured to the end of the casing of control 32a is attached to the push-pull means 33i of control 31a. Pivotally attached to the cap member is a T-shaped member 33j, the laterally extending arms of which are connected with push-pull plungers 33k and 33m, respectively, associated with controls 31b and 32b whose casings are secured to the housing 33f. These latter controls may be connected with the valve-operating means of the respective carburetors for regulating the speeds of the two engines. The push-pull means of the

control 32a is connected with the vertical arm of the T-member 33j and rocks the latter either clockwise or counter-clockwise, as desired, in response to manipulation of the control plunger. If member 33j is rocked counter-clockwise, it will tend to increase the speed of the engine connected with control 31b and decrease the speed of the engine connected with control 32b. Rocking of member 33j in a clockwise direction will produce the opposite effect. Thus, the control in one hand will cause the engine to change speed in unison while the control in the other hand will produce a differential action between the two engines.

As hereinabove indicated, any suitable means, either manual or automatic, may be employed for varying the pitch of the propellers. If manual means is employed, this may, if desired, be placed under control of one or both of the controls 31 and 32. For example, the pitch of each propeller may be varied as the speed of its engine is varied, i. e., both speed and pitch may be increased or decreased simultaneously. Alternatively, one of the controls may regulate the speed of the two engines simultaneously while the other control may regulate the pitch of both propellers. However, it will ordinarily be desirable to vary the pitch of the propellers at only infrequent intervals, as in going up to the higher speeds of flight and in slowing down from high speeds. Accordingly, it is considered preferable to provide a separate manual control for the propeller pitch which is independent of the two hand controls 31 and 32. Such separate control may be of the same character as the controls 31 and 32 but may have its manually operable end attached in any suitable manner at an appropriate point on the front of the flyer's uniform or suit.

Referring now to Figs. 11 to 14, inclusive, suitable mechanism is illustrated for varying the pitch of the propeller under manual control. As shown, the propeller may comprise a central spider member 191, a hub portion of which is mounted upon the engine shaft 171 and secured for rotation with the latter. Each arm of the member 191 is formed as a socket arranged to retain a ball-bearing 192 in which is journaled the inner end 193 of a propeller blade 194. Secured to the journal portion 193 of each propeller blade 194 is an arm 195 which is connected by a link 196 with a cylindrical member 197. This member carries the inner raceway of a ball-bearing unit 198, the outer raceway of which is carried by an annular member 199. It will be understood that member 197 is connected with all three of the propeller blades 194, shown in Fig. 11, by means of three of the links 196. At diametrically opposite points the annular member 199 is provided with radially projecting lugs or ears 200, which are connected by links 201 with the ends of a pair of laterally extending arms 202 forming part of a yoke 203 (Fig. 13) pivotally supported at 204 upon an arm or bracket 205 secured to or forming part of the housing 206 of the engine. An arm 207 of the yoke 203, which extends outwardly from the pivot 204, is suitably connected with the push-pull means 208 of the flexible control whose casing 209 has its end secured to the arm or bracket 205. It will be seen from the foregoing that upon inward pressure of the control plunger, similar to plunger 33 of Fig. 8, the push-pull means 208 will be depressed (Fig. 14) and will rock the yoke 203 in a counter-clockwise direction. The yoke then acting through links 201 will shift the bearing ring 199 upwardly

(Figs. 12 and 14) and the ring will carry with it the inner member 197. The latter, acting through links 196, will rock the arms 195 and thus rotate the three propeller blades 194 to vary their pitch. It will be understood that through the provision of a detent similar to that shown at 34a in Figs. 8 and 9, the propeller blades may be held in any position to which they may be adjusted by the control means.

The flyer is preferably equipped with a parachute 35, which may be worn in any conventional way by the flyer. It may, for example, be strapped to his back outside of the fuel tank members 22 and 23. Any conventional arrangement for retaining the parachute, such as straps 36, may be employed and these straps may pass around parts of the flyer's body. The arrangement is preferably such, also, that connections are provided to the parachute directly from the Venturi rings and the fuel tank so that the load of these parts will not be borne by the flyer when the parachute is put into use. Straps 37 may, for example, be employed to connect the Venturi rings directly with the parachute. Other similar straps may connect the air-foils or fuel tank directly with the parachute. The arrangement may, in fact, be such that the flyer himself is not directly suspended from the parachute but is carried through the intermediary of the fuel tank or other parts of the apparatus which are connected, as indicated, directly with the parachute. Any suitable arrangement may be provided for releasing the parachute. An ordinary rip cord may be employed, if desired, although, preferably, to expedite the release and opening of the parachute, it is effected by a small explosive charge which may be set off electrically or otherwise by striking a button 38 on the flyer's chest.

In order to enable the flyer to withstand the air pressure and the chilling effect created by his rapid flight through the air, he is preferably garbed in a wind-and-water resistant uniform adapted to fit snugly over warm undergarments of any appropriate type. If desired, the outer garment or uniform may be provided with suitable stiffening members, such as light metallic or plastic shields or caps or the like, adapted to fit over different portions of the body, such as the shoulders, arms, chest and so on. Such stiffening members, if employed, would enable the better streamlining of the flyer's body and, thus materially reduce his resistance to flight. Preferably, also, the flyer should wear a headgear 39, which may similarly be shaped for streamlining purposes and which preferably includes a transparent, mask portion 40, formed of Plexiglas or the like, adapted to fit over the face of the flyer. Suitable openings should be provided, or other provisions should be made, for allowing the circulation of air within the helmet without subjecting the interior of the helmet to either undue pressure or a suction action. The action of the lungs of the flyer may then be substantially normal even though he is moving at a rapid rate through the air. Suitable small wings or air-foils 41 may be provided at the sides of the headgear to produce a slight lifting action as the flyer moves through the air in a substantially horizontal position. The angle of the air-foils 41 should be such that the lift imparted to the head will simply relieve the strain on the flyer's neck muscles, which would normally be encountered in holding his head up, against the action of gravity, while stretched out in a substantially horizontal position.

Referring now to Fig. 5, there are illustrated various positions assumed by the flyer in the course of taking off, normal flying, and landing. In taking off, as indicated at 42, the flyer stands erect with his feet apart, in the manner shown in Fig. 1, and the engines are started. Any suitable means, of light construction, may be employed for self-starting purposes. For example, a small compressed air-operated motor may be provided for each engine or a small explosive cartridge may be provided for the purpose. However, if desired, the engines may simply be started by manual whirling of the propellers. The flyer may simply grasp the ends of the blades for this purpose or a small disk or pulley may be provided on the engine shaft, such pulley being adapted to receive a starting rope similar to that employed in starting outboard motors. As a further alternative, a kicker of the type used on motorcycles may be employed. When the engines are properly warmed up, the flyer may step up their speed to the point where a sufficient lift is created by the propellers to raise the flyer, with his load, from the ground. If manually controlled, adjustable propellers are employed, these may be suitably rotated to bring about an increased lifting action. After the flyer has attained a suitable elevation, as indicated at 43 in Fig. 5, he may begin to tilt the Venturi rings somewhat in the manner shown at 44. For this purpose the flyer may find it desirable to bend his knees and assume a somewhat squatting position, pressure being exerted through the toes to depress the forward portions of the Venturi rings. Gradually the rings may be swung more and more until their axes are substantially horizontal, and the flyer may then stretch out in a nearly horizontal position, as indicated at 45 in Fig. 5. It should be noted, however, that the flyer is not strictly horizontal; his body is inclined upwardly at a sufficient angle to provide a desired lifting force as a result of his high speed movement through the air. As the flyer approaches his destination, he may slacken his speed and by again flexing his toes and ankles to tilt the Venturi rings, he may assume the position indicated at 46, at the same time reducing his speed of movement by proper control of the engines or the pitch of the propellers or both. He may then gradually swing back to the vertical position, as indicated at 47, which may be described as the hovering position, and then by proper control of the engine speed, the flyer may gradually drop by gravity to the ground, as indicated at 48.

It should be noted that the Venturi rings 10 and 11 serve a number of different purposes. In the first place, they provide a protective enclosure for the propellers so as to prevent engagement of the propellers with the ground or with any other obstacle which might damage them. This purpose could, of course, be served in a variety of different ways, as by means of simply three or more vertically disposed rods or legs connected in some suitable way with the central supporting ring or cylinder 16. Thus, each of the spider arms 15 might carry a rod or leg at its end extending parallel with the axis of the engine shaft a sufficient distance to provide the function set forth. However, a second important purpose of the Venturi rings is to provide a suitable air-foil or lifting and stabilizing

surface capable of maintaining the proper lift on the engine units attached to the flyer's feet as he is traveling horizontally through the air. The axis of each of the Venturi rings will not at this time be strictly horizontal but will be inclined, by proper movement of the flyer's legs and ankles, to impart the desired lifting effect. If each of the rings is approximately 3 feet in diameter and 1 foot deep, it will be seen that each provides a lifting surface of approximately 6 square feet, i. e., the projected area of both the upper and lower halves. Surfaces of similar area under the control of the flyers' legs and ankles could, of course, be provided in other ways, as by wing or vane surfaces of entirely different shape. For example, in lieu of a ring surrounding each propeller, there might be provided a square or rectangular box-like structure. This could serve the first-mentioned protecting function also. Or, if desired, a single flat wing or vane might be provided either above or below the engine and propeller. However, an advantage of the construction illustrated is that it insures a constant flow of air at high velocity through the rings by the action of the propeller, regardless of the actual air-speed of the flyer. This insures unstalled flow through and about the ring even though the inclination of the airfoil sections to the direction of motion is such as would otherwise cause a breakdown of the flow or stall. Moreover, the rapid movement of air through the rings insures a proper cooling action upon the motors regardless of the actual speed of flight. A third important purpose or advantage of the Venturi ring construction is that it somewhat enhances the lifting effect of the propellers. This improvement in the lifting effect of the propellers is increased as the depth or length of the rings is increased in relation to their diameter. It may be quite substantial if the depth of the rings is made great enough in relation to their diameter. In designing a particular unit in accordance with the invention, it becomes a question, therefore, whether the improved efficiency due to the use of deeper rings more than offsets the extra weight incident to such use. For certain purposes and under certain circumstances, each construction may have its advantage over the other.

In the use of the improved construction, the flyer's sense of balance and his natural reflexes to any toppling sensation will assist him in his control of the apparatus. It will be noted that there is extreme flexibility in its control due to the ability of the flyer to shift each of the Venturi rings angularly in any direction with respect to the other. The control and flexibility of the apparatus is increased, moreover, if the connections from the control cables **31** and **32** are such that the speed of each engine may be varied independently of the other and the pitch of each propeller may be similarly varied independently of the other. As the flyer is taking off, and also as he is about to land, it is desirable to maintain the two Venturi rings with their axes along substantially vertical lines. It is also desirable to maintain substantially equal lift in the two rings, preferably by establishing equal engine speed and equal propeller pitch for the two units. However, when the flyer is in forward flight, and particularly when his body is horizontally disposed, as indicated at **45** in Fig. 5, the course of the flyer may be readily varied in any one of a number of different ways. For example, assuming that the flyer wishes to turn in a clockwise direction about a vertical axis, he may, by a sidewise tilting of one or both of the Venturi rings, produce a steering effect similar to that obtained from a rudder. Turning in this manner may be accomplished without varying the speed of the engines or the pitch of the propellers. On the other hand, the same effect may be obtained by increasing the speed of the propeller within the ring attached to the flyer's left foot. Should the flyer wish to roll about a horizontal axis while in the position of flight indicated at **45**, so as to produce a banking effect in making a turn to the right, for example, he may simply tilt the ring attached to his left foot to a slightly greater extent about its horizontal diameter than the device attached to the right foot, thereby increasing the lift upon the left foot. In lieu of the methods set forth above, steering may be accomplished by a simple bending movement of the body in the desired direction. By muscular exertion, the flyer may bend his body at the waist either to one side or the other and thus produce a corresponding turning tendency. After some experience in the maneuvering of the apparatus, a flyer should be able to control it and maintain his balance with it in much the same way as a person controls his movements on skates or on a bicycle or motorcycle.

While I do not wish to limit myself to any specific dimensions or details of the various portions of the apparatus, a pair of connected Venturi rings of the character disclosed above, each having an engine capable of developing 40 H. P., should be able to carry a flyer having a total weight, with his equipment, of, say, 380 lbs., a distance of between 125 and 350 miles, depending upon the extent of streamlining provided and the speed of flight. This is on the assumption that the wing structure **22** and **23** is so formed as to be capable of retaining 30 lbs. of gasoline. The flyer may attain a forward velocity of between 125 and 200 miles per hour in the course of his flight in a horizontal position. His forward speed in the positions indicated at **44** and **46** in Fig. 5 will ordinarily be below 100 miles per hour. The speeds attainable, as well as the distances through which the flyer may travel non-stop, will vary considerably in accordance with the extent of streamlining employed in connection with the apparatus and also the body of the flyer through the use of shields and the like embodied in his garments.

Referring now to Figs. 6 and 7, a somewhat modified form of construction is illustrated. Here the two Venturi rings **50** and **51** are rigidly connected, respectively, with tubes or sleeves **52** and **53**. These sleeves, in turn, are mounted for free turning movement about a shaft or connecting rod **54** passing through them and having a bearing fit with respect thereto. A nut **55** with any appropriate locking means, at each end of the connecting rod and cooperating with a thrust disc **56**, may serve to retain the parts in assembled relation and prevent separation of the sleeves **52** and **53** and their connected Venturi rings beyond the positions indicated in Fig. 6. Foot rests **57** integral with the tubes **52** and **53** may be so located as to provide a comfortable stance for the flyer. An advantage of this construction is that the flyer need not keep his feet spread as far apart as in the Fig. 1 construction. Accordingly, the foot rests may have their upper surfaces substantially in a horizontal plane, instead of being inclined as in the first embodiment. A disadvantage of this construction, on the other hand, is that it is less flexible than the form

shown in Fig. 1. The Venturi rings are simply capable of rotation relative to each other about the axis of the connecting rod 54. They are not capable of sidewise or transverse rocking with respect to each other. In other respects the modified construction may be substantially the same as for the embodiment of Figs. 1 to 4. This applies to the form and monuting of the engine and its propeller for each ring and the controls for varying the engine speeds and the pitch of the propellers. Since the modified construction is incapable of sidewise or transverse tilting of one Venturi ring with respect to the other, steering of the flyer, while in horizontal flight, and other maneuvering is not subject to such flexibility of control as in the first construction. But the various desired movements of the flyer may be brought about in one or another of the ways hereinbefore mentioned, which does not require relative transverse tilting of the units. In the modified form the parachute straps 58 may be connected with the sleeves 52 and 53 in lieu of being connected with the Venturi rings or the engine housings, as in the first construction.

While a preferred form of the flying apparatus and a possible modification of the same have been described in considerable detail, and the new method of flying involved in the use of the improved apparatus has likewise been set forth in detail, it will be understood that numerous changes may be made in the construction and arrangement of the various parts and in the procedure followed without departing from the general principles and scope of the invention.

I claim:

1. Flying apparatus which comprises a pair of connected power members each having foot supporting means arranged to receive one of the feet of a flyer, said members connected for independent angular adjustment by the feet of the flyer, propelling means carried by each of said members, and means for controlling the delivery of power to said propelling means.

2. Flying apparatus which comprises a pair of connected power members each having foot supporting means arranged to receive one of the feet of a flyer, said members being connected for independent angular adjustment by the feet of the flyer, each of said power members having a surface thereon adapted to impart lift thereto in response to relative movement between the same and the air, propelling means carried by each of said members, and means for controlling the delivery of power to said propelling means.

3. Flying apparatus which comprises a pair of connected power members each having foot supporting means arranged to receive one of the feet of a flyer, said members being connected for independent angular adjustment by the feet of the flyer, each of said power members having a surface thereon adapted to impart lift and lateral forces thereto in response to relative movement between the same and the air, propelling means carried by each of said members, and means for controlling the delivery of power to said propelling means.

4. Flying apparatus which comprises a pair of connected power members each having foot supporting means arranged to receive one of the feet of a flyer, said members being connected for independent angular adjustment by the feet of the flyer, each of said power members having a surface thereon adapted to impart lift and lateral forces thereto in response to relative movement between the same and the air, the magnitude of the lift and lateral forces being variable in response to the foot movements of the flyer, propelling means carried by each of said members, and means for controlling the delivery of power to said propelling means.

5. Flying apparatus which comprises a pair of connected power members each having foot supporting means arranged to receive one of the feet of a flyer, said members being connected for independent, universal, angular adjustment by the feet of the flyer, propelling means carried by each of said members, and means for controlling the delivery of power to said propelling means.

6. Flying apparatus which comprises a pair of connected power members each having foot supporting means arranged to receive one of the feet of a flyer, said members being connected for independent angular adjustment by the feet of the flyer, variable pitch propelling means carried by each of said members, means for varying the pitch of said propelling means, and means for controlling the delivery of power to said propelling means.

7. Flying apparatus which comprises a combined power and propelling unit, means on said unit adapted to be attached to the feet of a flyer, said unit having propelling means arranged to impart a lifting and pushing force lengthwise of the flyer's body through his feet, fuel storage means adapted to be attached to the flyer's body and arranged to supply fuel to said unit, said fuel storage means being constructed and arranged to form an air foil, and manually operable means for varying the lifting and pushing force of said propelling means.

8. Flying apparatus which comprises a combined power and propelling unit, means on said unit adapted to be attached to the feet of a flyer, said unit having propelling means arranged to impart a lifting and pushing force lengthwise of the flyer's body through his feet, fuel storage means adapted to the attached to the flyer's body and arranged to supply fuel to said unit, said fuel storage means being constructed and arranged to form an air foil, supplementary air foil means mounted on the flyer's head, and manually operable means for varying the lifting and pushing force of said propelling means.

9. Flying apparatus which comprises a pair of ring-like members, means for retaining said members in predetermined spaced relation but enabling independent relative angling thereof, said members having inner and outer surfaces combining to form an air-foil configuration, power means mounted within each member, a propeller within each member arranged to be driven by said power means, means for attaching said members to the feet of a flyer so as to impart a lifting and pushing force to the flyer through his feet, and means disposed adjacent the hands of the flyer for controlling the operation of said power means and propellers.

10. Fying apparatus which comprises a pair of ring-like members, a pair of rods each having a universal connection with both of said members for retaining said members in predetermined spaced relation but enabling independent relative angling thereof, said members having inner and outer surfaces combining to form an air-foil configuration, power means mounted within each member, a propeller within each member arranged to be driven by said power means, means for attaching said members to the feet of a flyer so as to impart a lifting and pushing force to the flyer through his feet, and means disposed

adjacent the hands of the flyer for controlling the operation of said power means and propellers.

11. Flying apparatus which comprises a pair of ring-like members, means for retaining said members in predetermined spaced relation but enabling independent relative angling thereof, said means comprising a bearing sleeve secured to each of said members and a shaft journaled in both of said bearings and serving to tie the same together, said members having inner and outer surfaces combining to form an air-foil configuration, power means mounted within each member, a propeller within each member arranged to be driven by said power means, means carried by said bearing sleeves for attaching said members to the feet of a flyer so as to impart a lifting and pushing force to the flyer through his feet, and means disposed adjacent the hands of the flyer for controlling the operation of said power means and propellers.

12. Flying apparatus which comprises a combined power and propelling unit, means on said unit for supporting and retaining the feet of a flyer, said unit having propelling means arranged to impart a lifting and pushing force lengthwise of the flyer's body through his feet, said supporting means responding to rotation of the flyer's feet relative to his body and being so connected to at least a portion of said unit as to act thereon for varying the direction of said force relative to the body, and manually operable means for varying the lifting and pushing force of said propelling means.

13. Flying apparatus which comprises a combined power and propeller unit, means on said unit for supporting and retaining the feet of a flyer, said unit having propeller means arranged to impart a lifting and pushing force lengthwise of the flyer's body through his feet, said supporting means responding to rotation of the flyer's feet relative to his body and being so connected with at least a portion of said unit as to act thereon for varying the direction of said force relative to the body, manually operable means for varying the lifting and pushing force of said propeller means, and a normally folded but releasable parachute connected with said unit and with the flyer, the arrangement being such that the load of the unit is taken directly by the parachute when the latter is opened.

14. Flying apparatus which comprises impelling means, foot supporting and retaining means connected with said impelling means adapted for attachment to the feet of a flyer and arranged to impart a lifting and impelling force to the flyer through his feet, said supporting means being responsive to rotation of the flyer's feet relative to his body, and being so connected to said impelling means as to act thereon for varying the direction of said force relative to the body, power means for operating said impelling means, a fuel reservoir connected with said power means for supplying fuel thereto and manually operated means for controlling the supply of power to said impelling means.

15. Flying apparatus which comprises impelling means, foot supporting and retaining means connected with said impelling means adapted to be attached to the feet of a flyer and arranged to impart a lifting and impelling force to the flyer through his feet, said impelling means comprising an impeller attached to each of the flyer's feet, said foot supporting means being responsive to rotation of the flyer's feet relative to his body and being so connected to said impellers as to act thereon for varying the direction of said force relative to the body, power means for operating said impelling means, a fuel reservoir connected with said power means for supplying fuel thereto, and manually operated means for controlling said impellers both in unison and independently of each other.

16. Flying apparatus which comprises impelling means, foot supporting and retaining means connected with said impelling means and adapted to be attached to the feet of a flyer and arranged to impart a lifting and impelling force to the flyer through his feet, said impelling means including a variable pitch propeller attached to each of the flyer's feet, said foot supporting means being responsive to rotation of the flyer's feet relative to his body and being so connected to said impelling means as to act thereon for varying the direction of said force relative to the body, power means for operating said impelling means, a fuel reservoir connected with said power means for supplying fuel thereto, and manually controlled means for varying the pitch and speed of said propellers.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,240,669	Capps	Sept. 18, 1917
1,838,327	Salisbury et al.	Dec. 29, 1931
1,849,766	McGuire	Mar. 15, 1932
2,216,080	Johnson	Sept. 24, 1940
2,180,922	De Bothezat	Nov. 21, 1939
1,928,578	Turrell	Sept. 26, 1933
1,957,896	Marguglio	May 8, 1934
1,137,212	Jelalian	Apr. 27, 1915
1,867,759	Rehback	July 19, 1932

FOREIGN PATENTS

Number	Country	Date
411,240	French	Apr. 7, 1910
407,144	French	Dec. 22, 1909