Sikorsky Archives News

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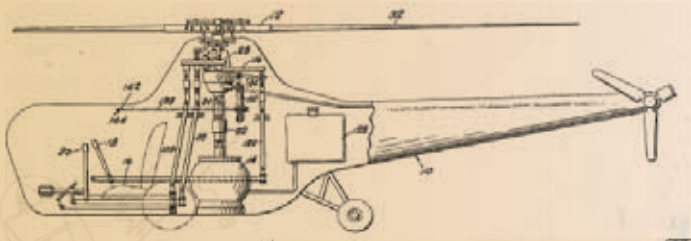
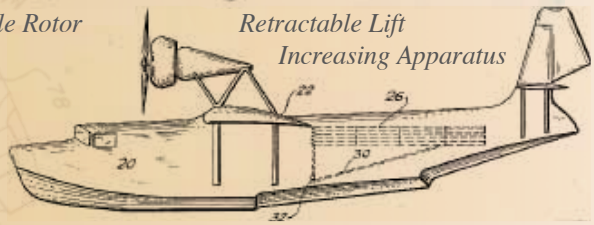
Igor Sikorsky's Inventive Genius Produced 66 Patents Awarded In America.

This issue is devoted to his unique conceptual designs that did not progress to production.

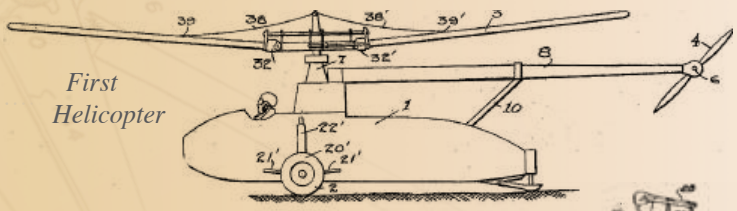
Igor Sikorsky was a hands-on engineer who would walk-the-boards, advising and contributing to the evolving preliminary and conceptual designs being created at the Sikorsky Aircraft facilities. His concepts and guidance to the design specialists provided the knowledge and experience gained during his early aviation pioneering ventures in Russia, France and the United States. His intuitive reasoning capabilities produced concepts that were technically advanced for the period. The Sikorsky Aircraft Company evolved and expanded due to a firm knowledge based foundation created by its founder.



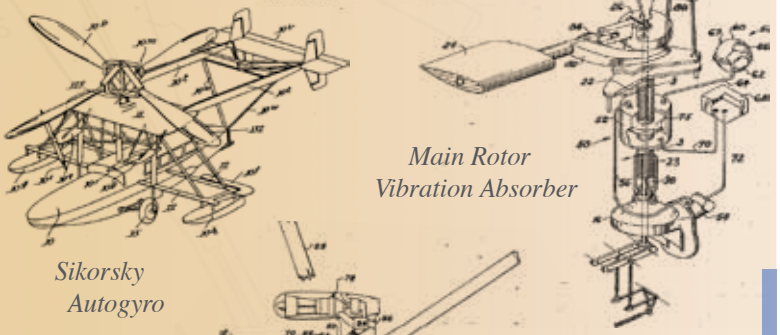
Adjustable Rotor



Retractable Lift Increasing Apparatus

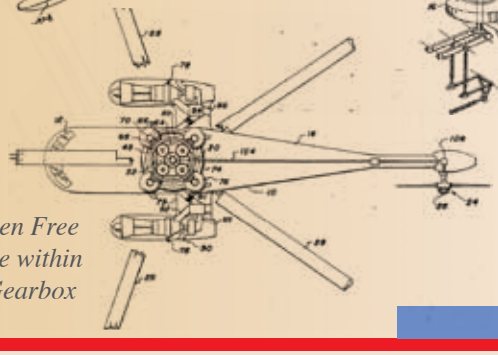


First Helicopter



Main Rotor Vibration Absorber

Sikorsky Autogyro



Engine Driven Free Turbine within Main Gearbox

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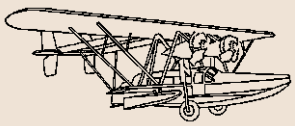

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July, 2011

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LIFT INCREASING APPARATUS

Patent No. 1,995,905 issued March 26, 1935

Large amphibious aircraft such as the S-41 and S-42 required more power to take off than land based aircraft due to the increased empty weight required for the boat hull structural integrity. The patent defines a mechanical hydraulically actuated retractable wing and airfoil structure located at the trailing edge of the main wing to increase lift during takeoff.

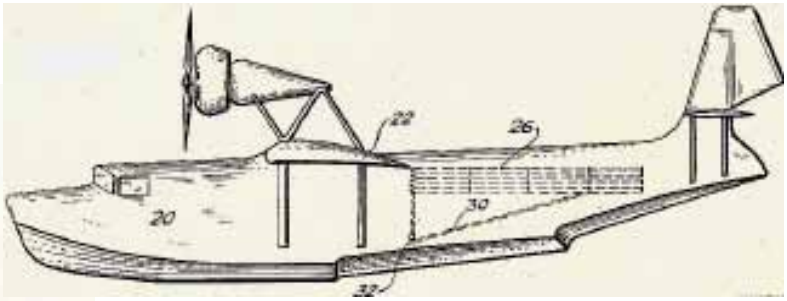


Figure (1)

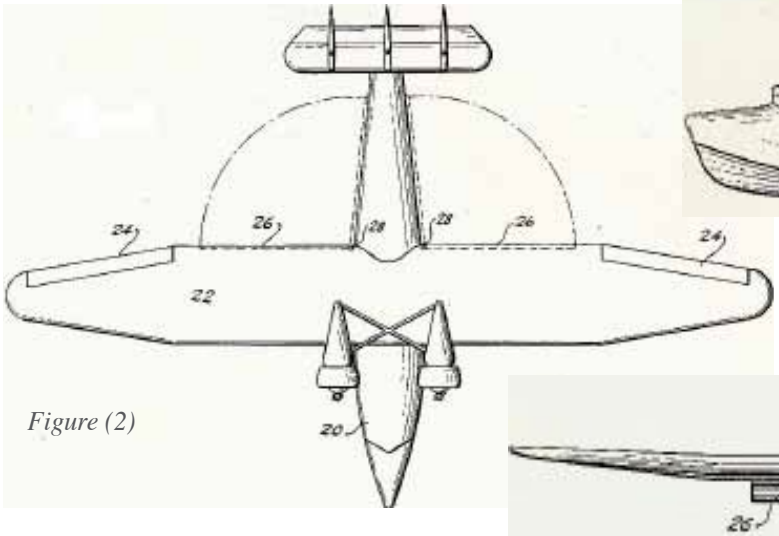


Figure (2)

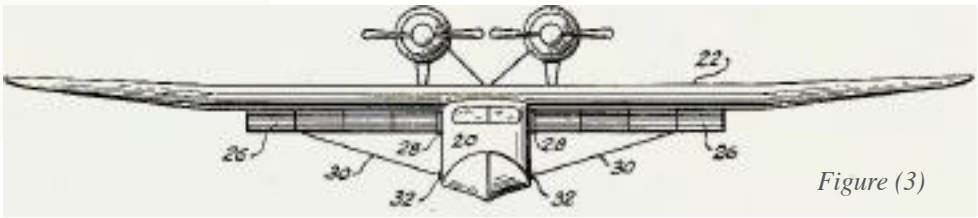


Figure (3)

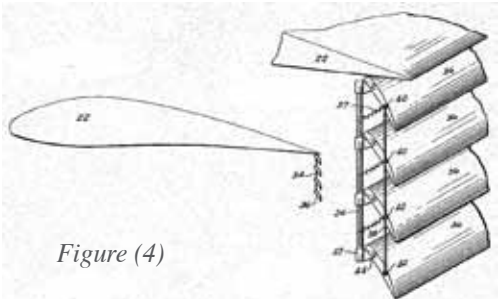


Figure (4)

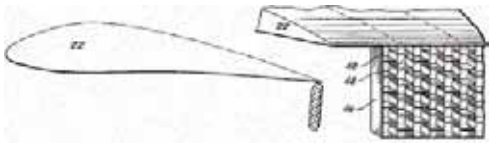


Figure (5)

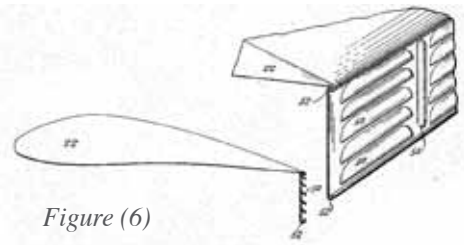


Figure (6)

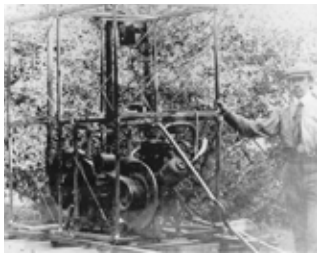
The lift increasing apparatus is comprised of two movable wing sections that are hydro mechanically actuated from the stowed position against the side of the fuselage shown in Figure (1) through an arc of motion shown in Figure (2), to the trailing edge of the main wing in the flight position shown in Figure (3). It is secured to the trailing edge of the wing and ready for flight. Various hydro mechanically movable airfoil sections are shown in Figures (4), (5), and (6). The locations, shapes and positions can be varied to improve the lift coefficient for take off, and for air braking purposes on landing.

DIRECT LIFT AMPHIBIAN AIRCRAFT
Patent No. 1,848,389 issued March 8, 1932

During Igor Sikorsky's successful aviation pioneering years in Russia and the United States, he had not forgotten his first aviation love and attempt to build a vertical lift aircraft the H1 and H2 at the age of 20. His patent for an autogyro brought the vision back from the past. The Sikorsky Aircraft Company was very successful during the early 1930s designing and building amphibians and flying boats. Igor Sikorsky combined the success of the S-38 and his desire to create a direct lift aircraft to the amphibian shown in Figure (1) and is defined in the subject patent.

S-38

The unique features of this patent combines the engine driven propeller power to provide the forward motion needed to take off, as well as air pressure to drive the direct lift rotor. This is accomplished through a system of air passages in the propellers. The pressurized air is distributed through a network of channels to the lifting rotor during the forward motion of the aircraft. The rotor total lift capacity is therefore a combination of its own aerodynamic capabilities and the reaction driven rotor blades.



H1

H2

One additional feature in this patent shown in Fig. (2) is a concept that establishes Igor Sikorsky as one of the first pioneers to conceive of a tilt rotor concept. Specific paragraphs in the patent define the following configuration:

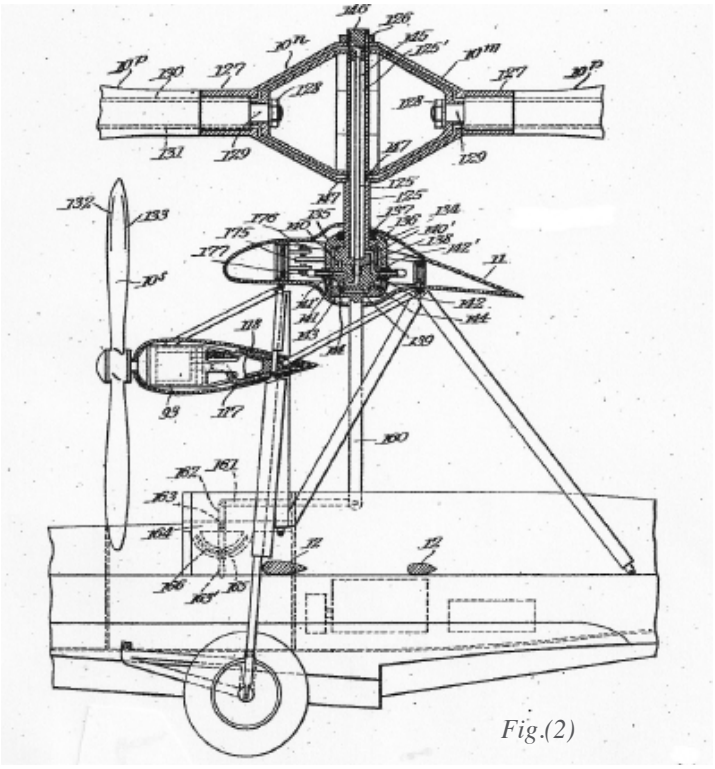


Fig.(2)

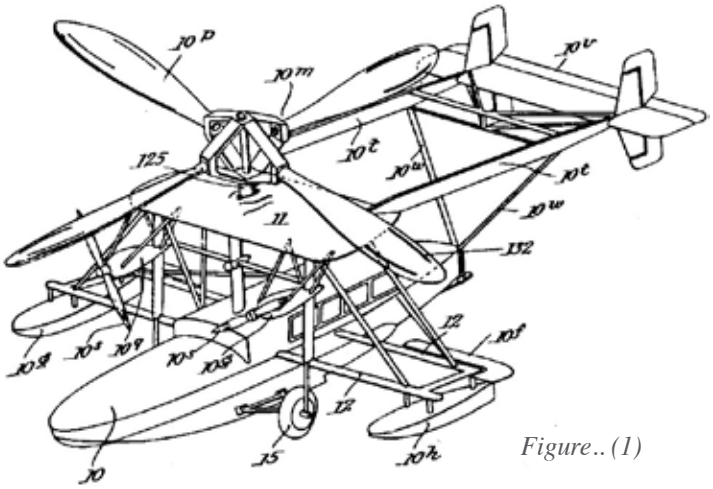


Figure.. (1)

"In an aircraft, a direct lift reaction driven propeller, a rotatable vertical shaft on which the propeller is mounted, an airfoil beneath said propeller, a transfer box for fluid medium under pressure and including bearings for said shaft disposed in said airfoil, and mounting means for said box to enable it to tilt to move the shaft relative to said airfoil out of its normal vertical position."

DIRECT LIFT AIRCRAFT

Patent No. 1,994,488 issued March 19, 1935

Igor Sikorsky returned to his dream of vertical take off aircraft in the early 1930s. The subject patent is his first for the helicopter and includes the required details relative to envisioned problems with torque compensation, directional steering, engine installation, power transmission to lifting and torque compensating rotors, lateral and longitudinal stability controls, and aircraft structural installation.

It is worthy to note that Igor Sikorsky's practical approach to design resulted in his first helicopter with a configuration of one main rotor and one tail rotor shown in Figure (1). He evaluated vertical and horizontal drive engine installations, and associated gearbox requirements shown in Figures (2) and (3). He selected hinged rotor blades as his first choice for the rotor system. Rotor system flight controls were all mechanical utilizing linkage members, chain and cable drive, and jack screws for mechanical advantage to minimize control forces for the pilot in the cockpit.

Sikorsky's first helicopter patent established the concept for a single main and single tail rotor configuration. This conceptual configuration is currently utilized for over 90 % of all current worldwide helicopters. This primary configuration required approximately four years of rotor development including number of rotors, placement of rotors, vibration and stability control systems for the rotors. The final practical configuration was embodied in the VS-300 experimental aircraft, which eventually launched the helicopter industry. The final configuration evolved in the early 1940s after numerous configuration changes including engine orientation, number of main and tail rotor configurations, flight control and airframe structural variations, Some of the configurations are illustrated below.

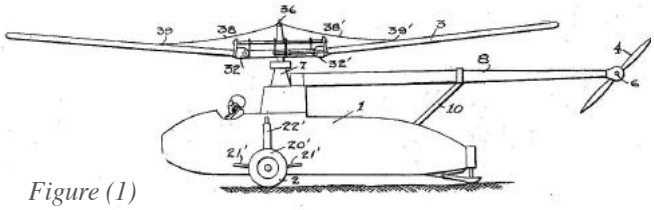


Figure (1)

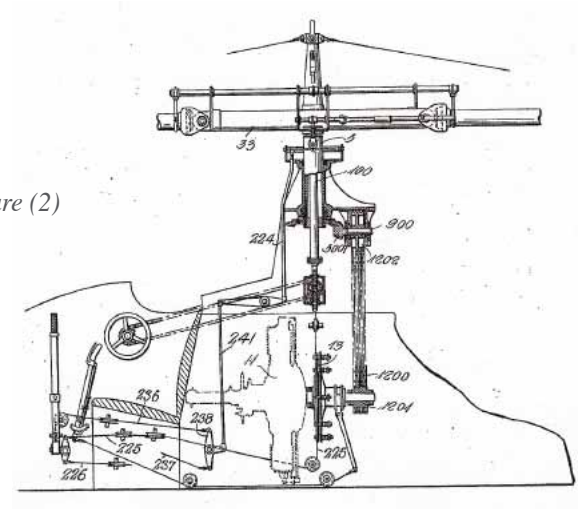


Figure (2)

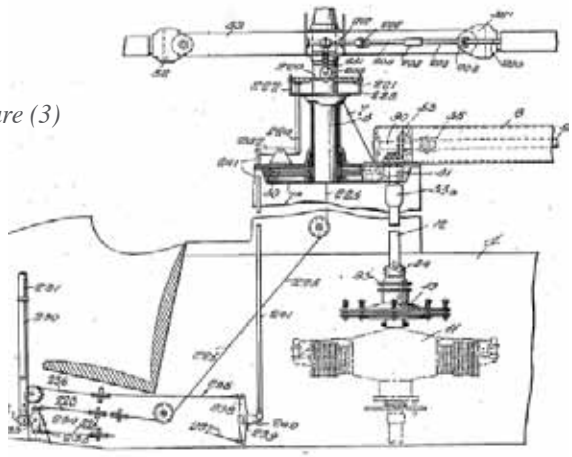


Figure (3)

ADJUSTABLE ROTOR

Patent No. 2,402,349 issued June 18, 1946

This invention was conceived during the S-51 time period, and was aimed at reducing the pilot workload during flight operations. When the aircraft center of gravity changes for any reason, the pilot would move the cyclic control to compensate for the change. To reduce the pilot inputs, the design mounts the main gearbox to airframe structure on gimbals. Universal joints are provided on the end of drive shaft between the engine and the gearbox per Figure (1). This allows the aircraft to tilt forward relative to the rotor blade disc position as the center of gravity moves forward with fuel burn off.

The rotor controls are designed with linkage and force multiplying mechanism to keep the rotor blade coning disc in the same position it was prior to the center of gravity change as shown in Figures (2) and (3) . Allowing the airframe to tilt while keeping the rotor in its prior status eliminates any pilot input reducing pilot work load. Igor Sikorsky was an engineer pilot and was ahead of his time. He was thinking helicopter automatic flight controls before they were invented.


S-51

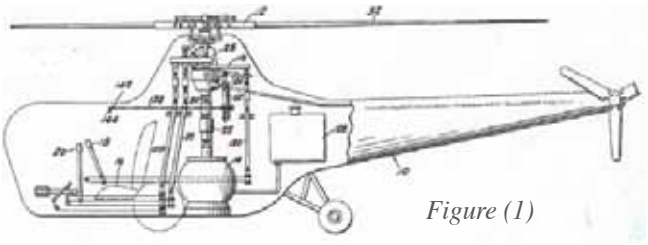


Figure (1)

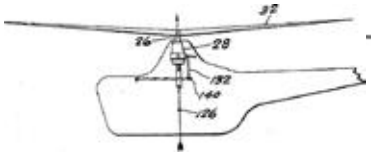


Figure (2)

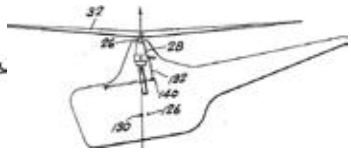


Figure (3)

ROTOR SUPPORT

Patent No. 2,494,209 issued January 10, 1950

This invention provides a damping and shock absorbing system for a helicopter rotor system shown in Figure (1). Means are provided to automatically change the pitch for blades of the rotor to vary the lift as a function of the vibration loads improving damping automatically. A hydraulically pressurized damper is located between the main rotor and main gearbox. The damper housing is attached to the airframe structure, and the damper piston is attached to the gear box main rotor drive shaft. The gearbox provides the hydraulic pump drive to pressurize the hydraulics for the accumulator and rotor damper shown in Figure (2). This invention was the start of many new approaches to provide the helicopter with rotor induced vibration damping and shock absorbing.

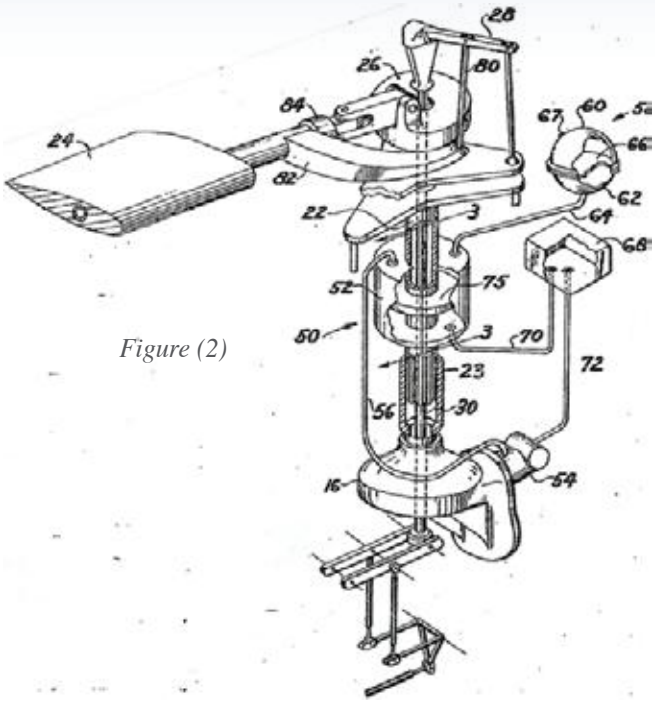


Figure (2)

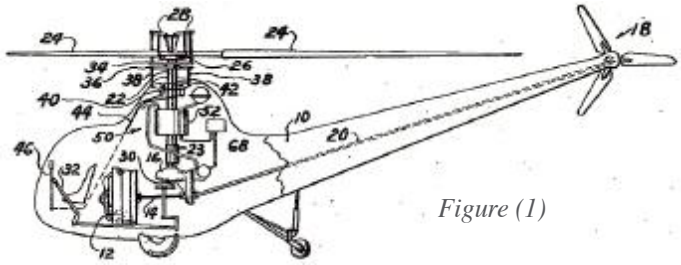


Figure (1)

VARIABLE PITCH CONTROL OF HELICOPTER COAXIAL ROTORS

Patent No. 2,663,372 issued December 22, 1953

This patent is for a coaxial rotor system, and the method of setting the collective and cyclic pitch of one rotor so that the aerodynamic and dynamic forces of that rotor will control and maintain the pitch settings of the second rotor as desired. This design provides a single large blade rotor counterbalanced with a weight and a smaller bladed pilot rotor counter rotating to the large rotor shown in Figure (1). A schematic of a dual engine drive system relative to the main rotor is shown in Figure (2). The smaller diameter pilot rotor is located above the larger single bladed rotor, and it develops lower aerodynamic loads and control forces. The cockpit controls are linked to the smaller rotor for required collective and cyclic pitch changes. The collective and cyclic pitch changes set by the pilot rotor are transmitted to the large counterbalanced main rotor by a system of control linkages, jackscrews and gears shown in Figure (2) and(3). Pilot workload in the cockpit is thereby reduced.

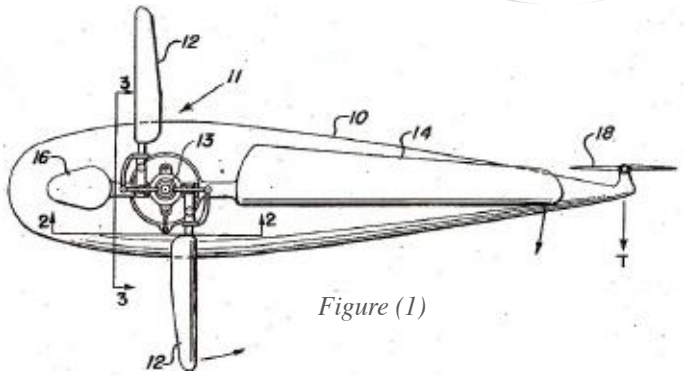


Figure (1)

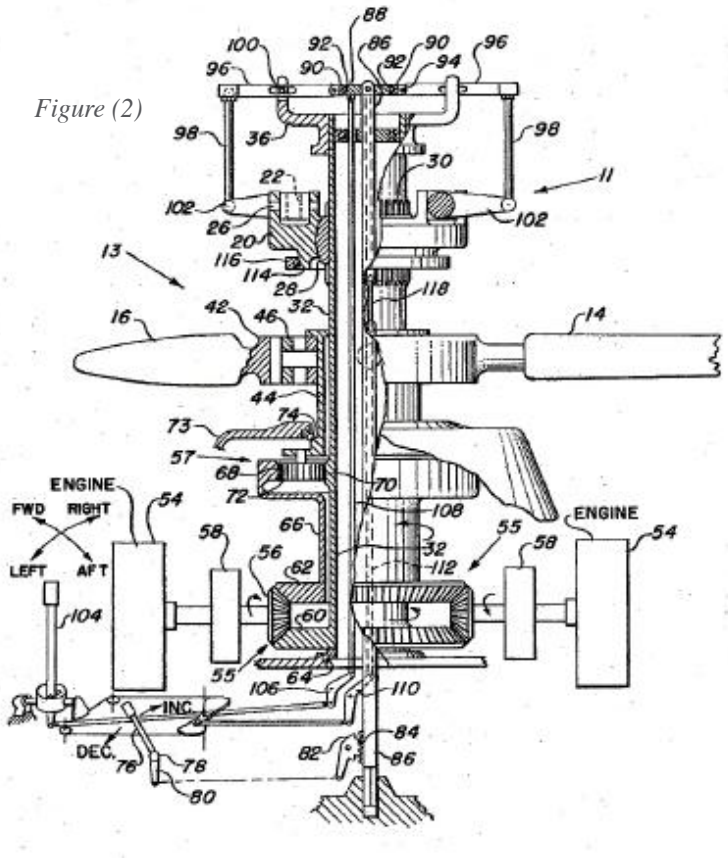


Figure (2)

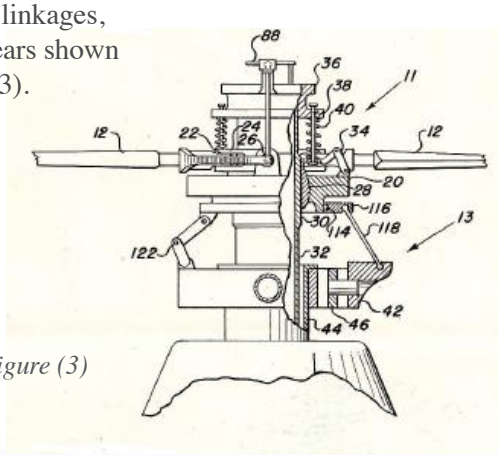


Figure (3)

H2 1910

100 YEARS FROM DREAM TO REALITY

Although Igor Sikorsky's helicopter legacy was the development of a single main rotor configured helicopter, he never forgot his initial attempt to build coaxial rotor systems, the H1 and H2 series.

ABC 1965

X2 2010

HELICOPTER POWER TRANSMISSION SYSTEM

Patent No. 2,944,609 Issued July 12, 1960


S-61


S-64


H-53/S-65

During the 1960s, medium and heavy lift helicopters were developed utilizing shaft turbine engines with front and rear drives like the S-61, S-64 and S-65 series. This patent is for a new approach to design a turbine drive propulsion system that improves the flexibility of locating the engine relative to the transmission system. The advantages of this design would eliminate drive shafts, clutches and gear reductions between the engine free turbine and the main transmission. It would simplify the gearbox and main rotor connections. An overall part count and weight reduction would be achieved.

Figure (1) is a view looking down on the aircraft with a cross section of the dual engines and the main gearbox. Figure (2) is a schematic of the two engine gas producers which direct the pressurized engine air into a duct system of four power turbines that drive input gears of the main gearbox shown in figure (3). The gearbox input speed is reduced via a three stage gear and planetary reduction to the main rotor head mounted integral to the main gearbox shown in figure (3). The overall result is a short hollow main rotor drive shaft that can be used as a power turbine hot air exhaust duct to the main blades for anti icing or blade tip jets. The envisioned benefits of the compactness, reduced parts, weight savings and flexibility of engine and power turbine placement, made this patent a unique conceptual design.

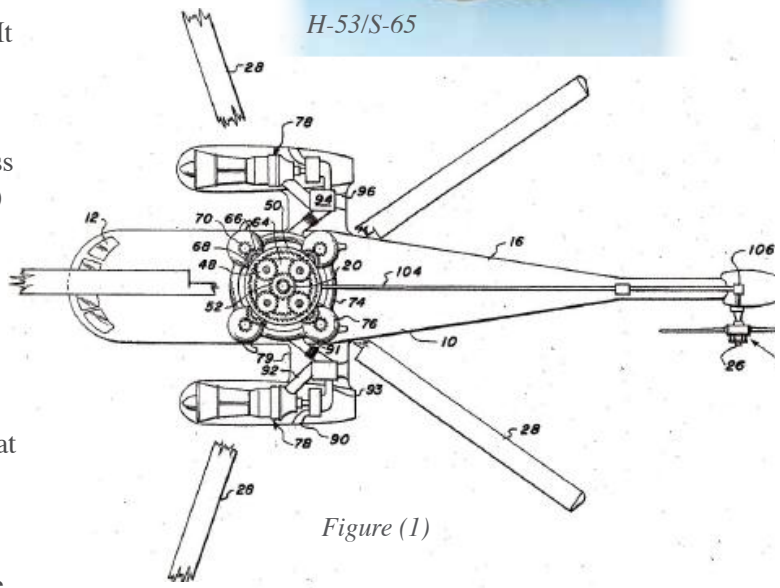


Figure (1)

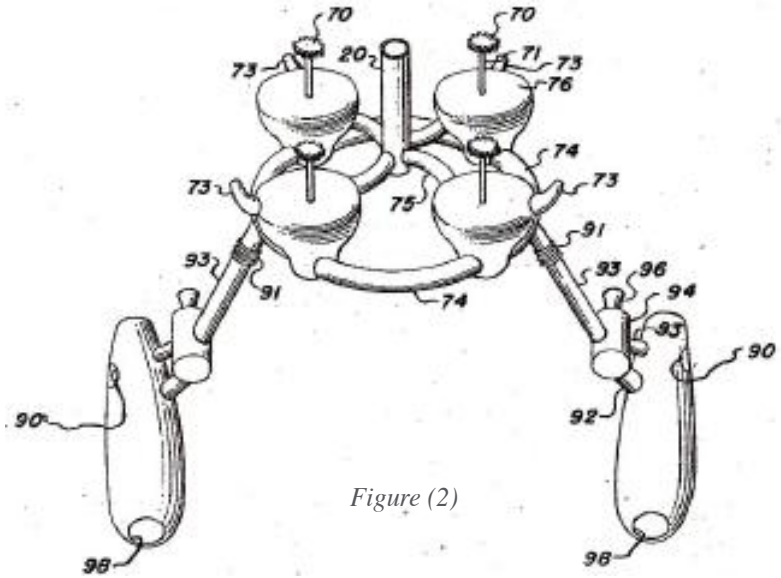


Figure (2)

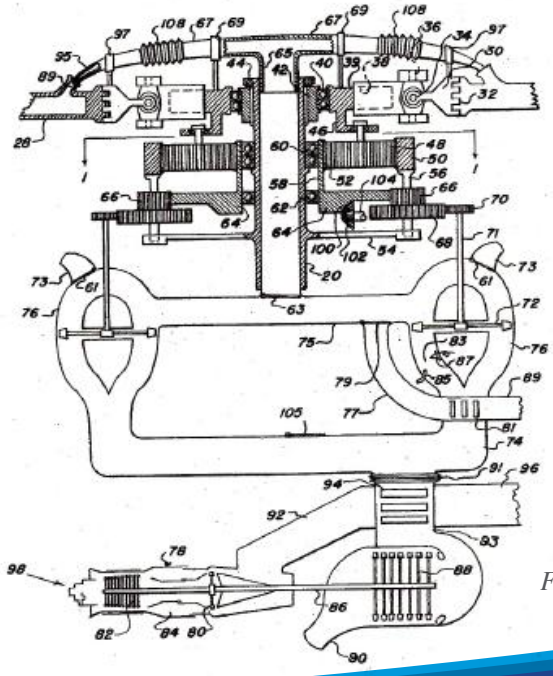


Figure (3)

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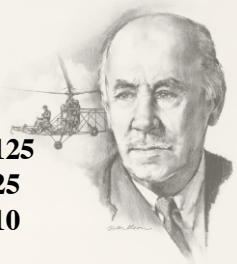

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Newsletter designed by Lee Jacobson and archive members

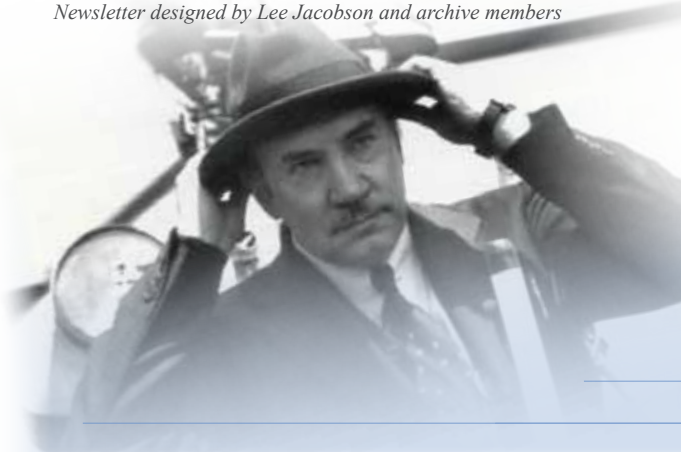
Igor Sikorsky responded to a request from The Associated Press as part of "I am An American Day" as follows:

I am happy to be an American because this great country is the stronghold of liberty and progress; because here each citizen can arrange his life and family as he wants it; can express freely any beliefs or opinions that he may have without fear of persecution or intimidation.

I am proud to be an American because this great country always has been the traditional carrier of idealism, good will, and help all over the world wherever there was need or suffering.

For myself and my four American-born sons, I am happy and proud to be a citizen of this great, powerful, free country, that has no reason to envy or fear any other country in the world.

Igor Sikorsky
April 20, 1941



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