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Pai

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(54) **LIGHTWEIGHT HELICOPTER**

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(52) **U.S. Cl.** **244/17.23**

(58) **Field of Classification Search** 244/17.23, 244/17.11, 2, 900
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,192,881	A	3/1940	Bothezat
2,461,348	A	2/1949	Pentecost
2,835,331	A	10/1958	Ryan et al.
2,938,679	A	5/1960	Walker, Jr.
3,029,047	A	4/1962	Jacobsen et al.
3,052,305	A	9/1962	Jones et al.
3,261,572	A	7/1966	Gorton
3,360,219	A	12/1967	Wigal
4,372,506	A	2/1983	Cronk et al.
4,458,860	A	7/1984	Ogawa

(Continued)

FOREIGN PATENT DOCUMENTS

DE	78 903	A	1/1971

(Continued)

OTHER PUBLICATIONS

International Search Report, PCT/IN01/00016; ISA/EPO, Oct. 3, 2001.

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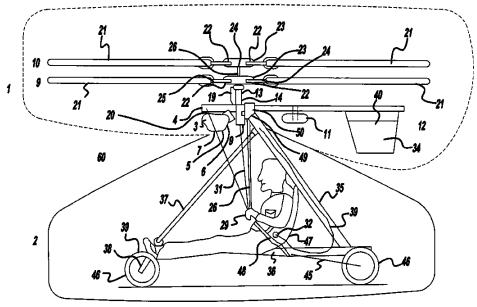
(57) **ABSTRACT**

The present invention relates to a lightweight helicopter with features of coaxial, contra-rotating rotors and weight shift control. It has a rotary wing unit attached to a tricycle assembly through a hang bolt. The rotary wing unit has an engine mounted below a keel post, which drives a pair of contra-rotating coaxial rotors through a primary gearbox and a secondary gear box. The keel post is attached to a triangular control frame, the base of which forms the control bar. The keel post also supports a fuel tank connected to the engine and a tail plane having one or more articulated vertical flaps actuated by cables. The secondary gearbox is provided with a free-wheeling clutch, a pinion gear and bevel gears for transmitting the rotary movement of the engine to the counter rotating coaxial vertical shafts each carrying two rotor blades of airfoil cross section fixed by pitch bearing on teetering plates and teetering hinges to form horizontal rotors. The tricycle assembly has a pilot seat and landing gear as well as controls for operation of the engine, rotors, tail plane and landing gear. The directional control of the helicopter is achieved through the weight shift principle by manipulating the control bar, thereby causing a tilt of the contra-rotating rotors, which cause a corresponding tilt in the aerodynamic thrust of the rotors, propelling the helicopter in the required direction.

6 Claims, 7 Drawing Sheets