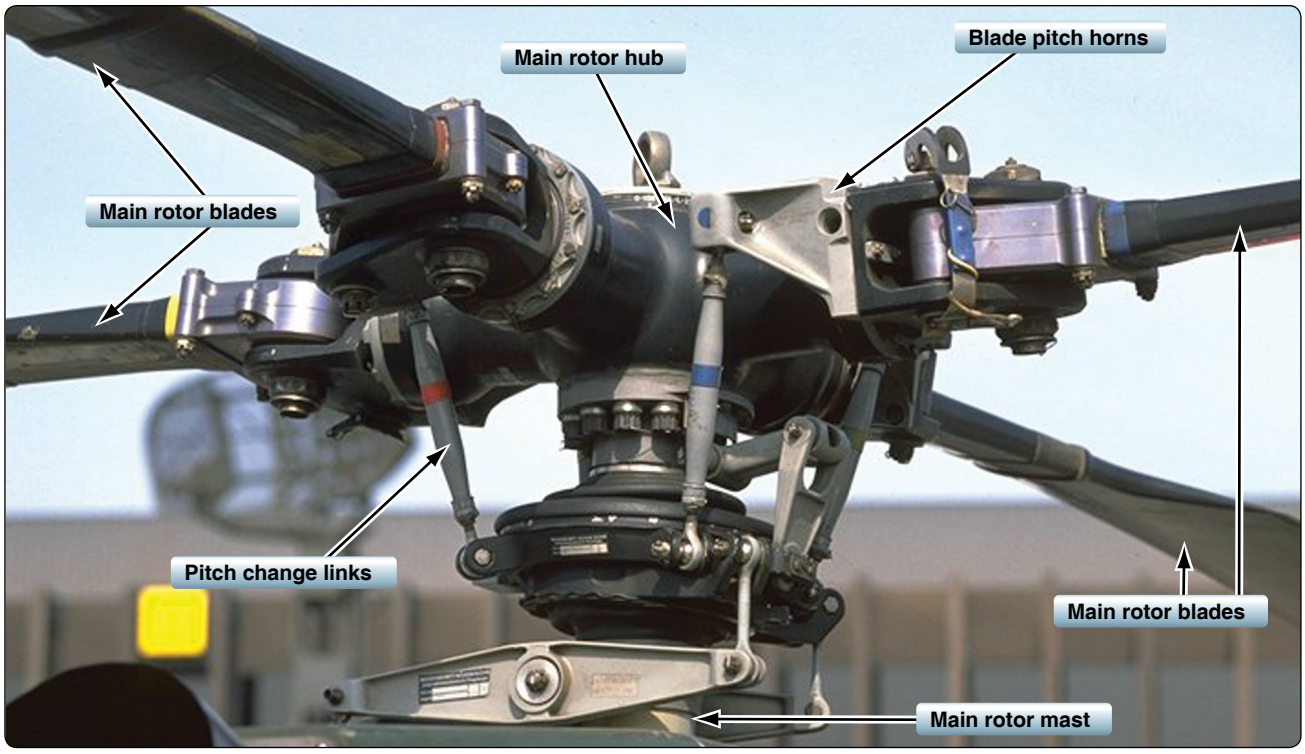

Figure 4-4. *Four-blade hingeless (rigid) main rotor. Rotor blades are comprised of glass fiber reinforced material. The hub is a single piece of forged rigid titanium.*

and materials continue to improve, rigid rotor systems may become more common because the system is fundamentally easier to design and offers the best properties of both semirigid and fully articulated systems.

The rigid rotor system is very responsive and is usually not susceptible to mast bumping like the semirigid systems because the rotor hubs are mounted solid to the main rotor mast. This allows the rotor and fuselage to move together as one entity and eliminates much of the oscillation usually present in the other rotor systems. Other advantages of the rigid rotor include a reduction in the weight and drag of the rotor hub and a larger flapping arm, which significantly reduces control inputs. Without the complex hinges, the rotor system becomes much more reliable and easier to maintain than the other rotor configurations. A disadvantage of this system is the quality of ride in turbulent or gusty air. Because there are no hinges to help absorb the larger loads, vibrations are felt in the cabin much more than with other rotor head designs.

There are several variations of the basic three rotor head designs. The bearingless rotor system is closely related to the articulated rotor system but has no bearings or hinges. This design relies on the structure of blades and hub to absorb stresses. The main difference between the rigid rotor system and the bearingless system is that the bearingless system has no feathering bearing—the material inside the cuff is twisted by the action of the pitch change arm. Nearly all bearingless rotor hubs are made of fiber-composite materials. The differences in handling between the types of rotor system are summarized in *Figure 4-5*.

Fully Articulated Rotor System

Fully articulated rotor systems allow each blade to lead/lag (move back and forth in plane), flap (move up and down about an inboard mounted hinge) independent of the other blades, and feather (rotate about the pitch axis to change lift). *[Figures 4-6* and *4-7]* Each of these blade motions is related

System Type	Advantages	Disadvantages
Articulated	Good control response	High aerodynamic drag. *More complex, greater cost.*
Semirigid (Teetering, Underslung, or See-Saw)	Simple, easy to hangar due to two blades	Reaction to control input not as quick as articulated head. Vibration can be higher than *multi-bladed articulated* systems.
Rigid	Simple design, crisp response	Higher vibration than articulated rotor.

Figure 4-5. *Differences in handling between the types of rotor systems.*