SPRING 2018

Flapping Wings

THE ORNITHOPTER SOCIETY NEWSLETTER

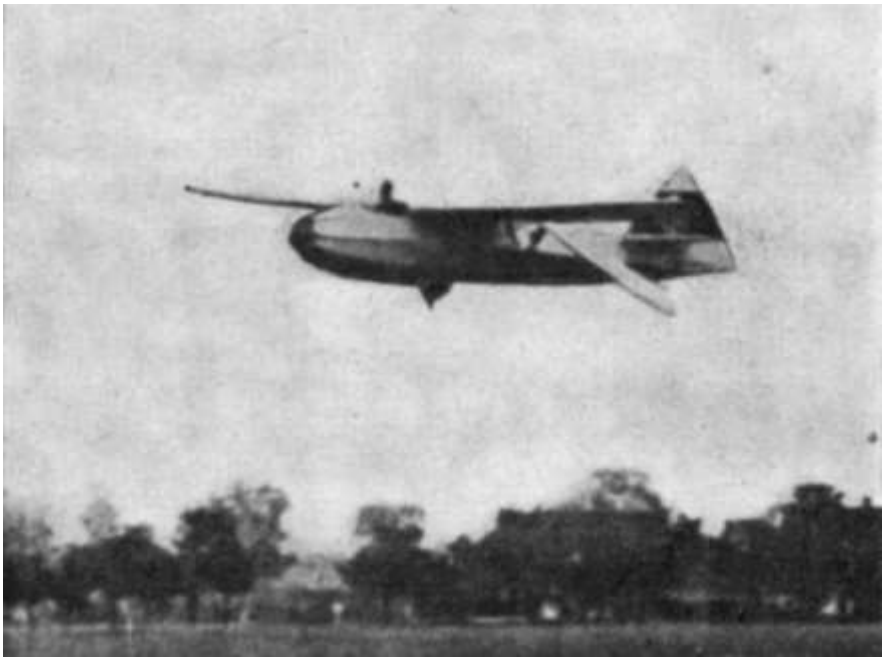
Schmid Mechanism Revealed!

by Nathan Chronister

It was 1942 in the shadowed years of the second world war when the first manned ornithopter took flight. Sadly lost, along with much else due to the circumstances of the war, Adalbert Schmid's great achievement is starting to see new light.

Schimd's work is known from several articles published in Germany after the war. He flew a manned ornithopter in 1942. Initially it was powered by the muscles of the pilot and towed aloft for a flight of 900 meters. Subsequently, a small motorcycle engine was added. That allowed the ornithopter to take off on its own. Flights of 15 minutes were reported.

The design of the ornithopter is known only from Schmid's simplified description and three photos somewhat lacking in detail. After examining these materials, off and on for several years, I finally began to tease out some secrets of the design.



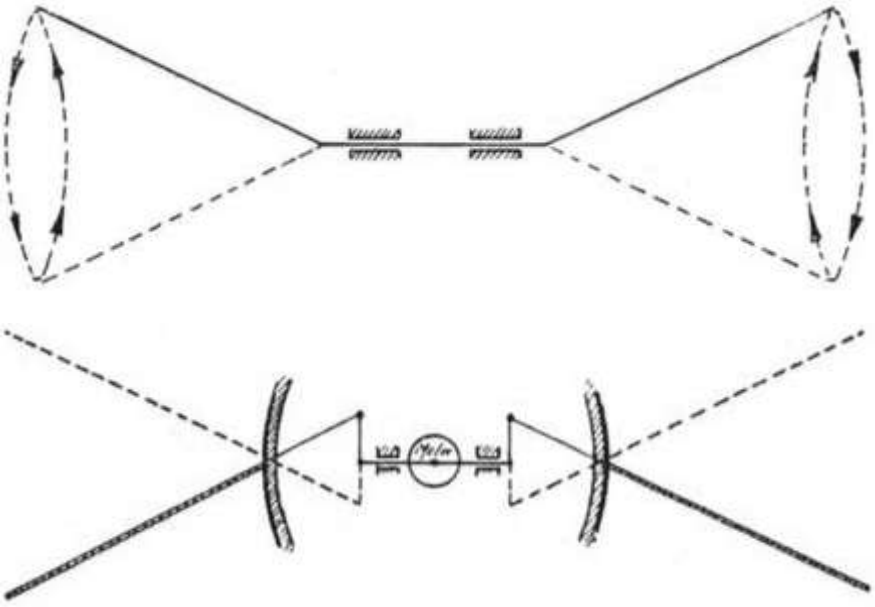
Adalbert Schmid's 1942 manned ornithopter in flight.

Schmid stated his ornithopter used a circular wing motion, and he provided two simplified drawings of mechanisms for producing such a motion. The drawings alone could not be translated into a practical mechanism. They show a rotating wing, but they don't reveal how to keep the wing upright as it goes around in the circle.

Studying the photos, I noticed what looked like an opening in the side of the fuselage. From this portal emerged what appeared to be a drive chain, like on a bicycle. A sprocket conveyed the power to a small, mysterious hub, which formed the base of the wing. Something in that small hub was flapping the wing.

The hub mechanism remained a mystery until I noticed a small bump, faintly visible in the grainy photo. I realized this was the axle of a gimbal mechanism. The bent drive shaft of Schmid's sketch would pass through the gimbal, and this would allow the wing to move in a circular path while remaining upright.

With this new understanding, I set about the task of building a model of the Schmid mech-



Adalbert Schmid's drawings hint at a mechanism for circular wing flapping. But some important details were missing.

anism. First I modelled the drive mechanism in a 3D CAD program, in order to work out the necessary dimensions and some details of the construction. Building this mechanism was challenging for me, because it is completely different from other ornithopter mechanisms that I have built before.

I used a miniature plastic drive chain on the model, giving it a scale-like appearance. Since I don't have any dimensions, it's not actually to scale. The plastic chain has a lot of friction, but the Schmid mechanism itself spins freely. Perhaps the circular motion of the wing is more efficient than a typical flapping mechanism.

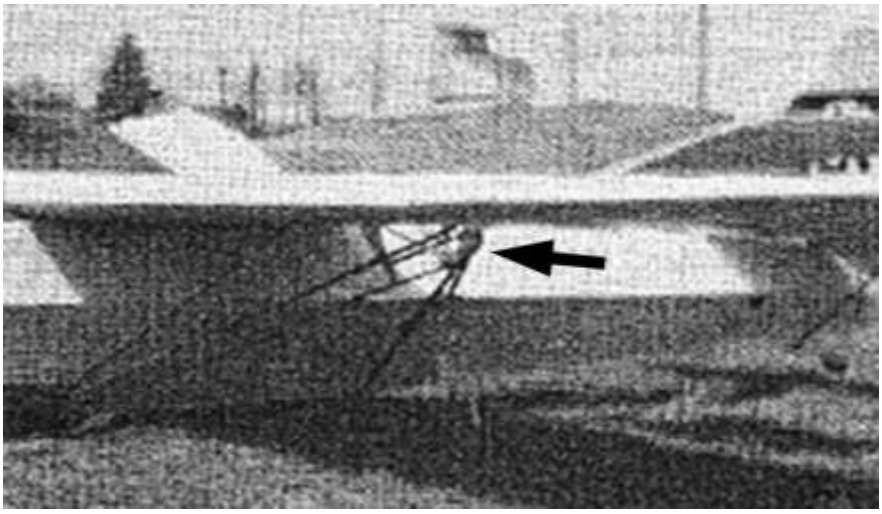
Until I built the model, I didn't understand why Schmid had the hub pointing up at an angle. Now I see that this arrangement causes the wing incidence to vary throughout the flapping cycle. The wing pitches up slightly for the upstroke, and it pitches down slightly for the downstroke, allowing it to maintain the correct angle of attack.

The stage is set for someone to build a flying model, or even a full-size "replica" of Schmid's ornithopter. This would serve as a demonstration of its airworthiness and help raise awareness of the historic accomplishment.

Wright or wrong?

Gustav Whitehead made the first successful flight of an airplane in 1901. Two successful replicas lent support to the eyewitness accounts that described Whitehead's airplane flying over their Connecticut town. The reconstructions, along with other evidence, have led to Whitehead now being recognized for building the first successful airplane.

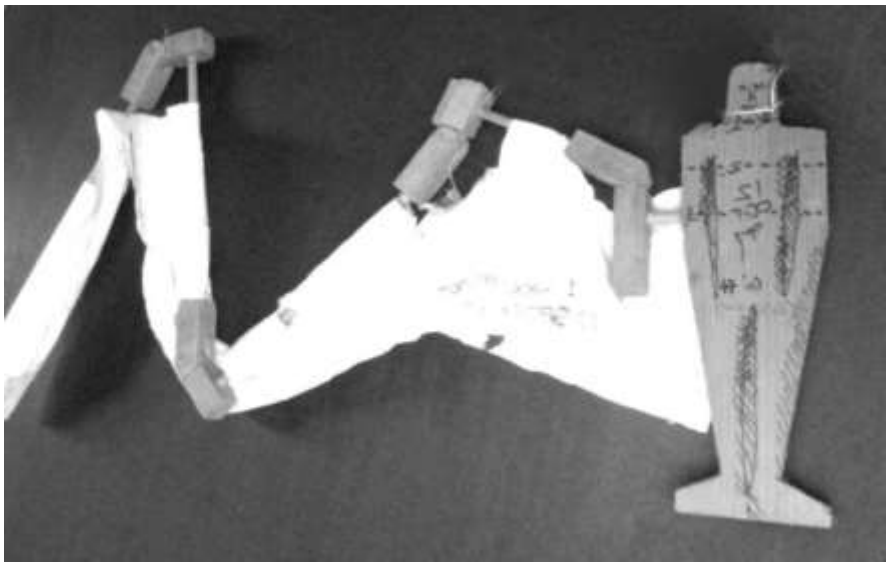
The Wright Brothers' flights made in North Carolina in 1903 were marginal by comparison. The best was an 852 foot straight-line flight that ended in a crash. That hardly qualifies as the sustained and controlled flight for which it was often claimed.



A photo of Adalbert Schmid's ornithopter shows a mysterious, compact flapping mechanism that is apparently driven by a bicycle chain and sprocket.

Articulated

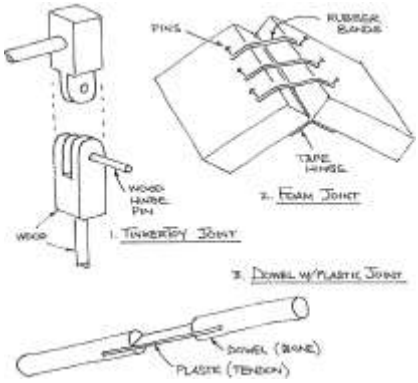
by Donald V. Cook



Several years ago, I built some test models of jointed wings - not rigid like a modern airplane. Articulated, like a bird skeleton, or human. My goal was not to actually fly these things, but just to be able to fold the wings. I wanted wings that were more portable, more manageable, for the lone pilot when he's not in the air. Safe on the ground, less sensitive to being blown away when at rest. But *also* capable of unfolding at the will of the pilot when the time for takeoff was right.

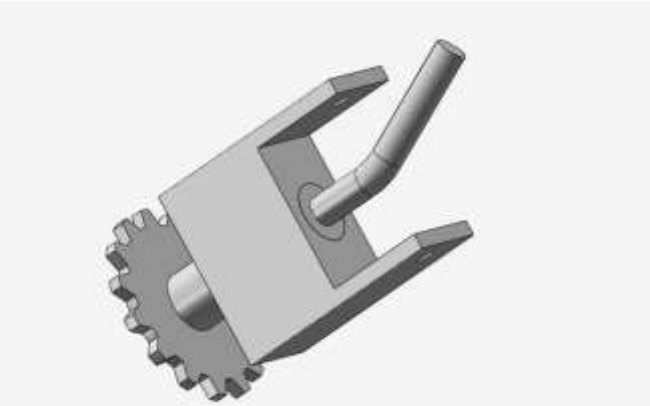
The first model is Tinker Toy-like, but it tells the story. The scale is 1½"=1'. So, my man is 6 ft. tall and his wingspan is a whopping 40+ feet. I wanted him to be able to stand up with his wings folded at his sides. You can see the skeleton joints clearly: fingers, wrist, elbow, shoulder, and an extra one added for good measure. The joint pieces are friction-fit so they can be easily adjusted. I envision that a future pilot would launch hunched over and fly in a horizontal posture. No ideas are suggested as to how the wings would deploy or retract.

Second is a ¾" foam wing cut from housing insulation. Obviously no skeleton required in this version. Here the joints are cut flush: tape hinges applied on one side of the panel, the other side secured with rubber bands at each joint. In action, the rubber tension deploys the articulated sections nicely, but I offer no suggestion as to retraction.

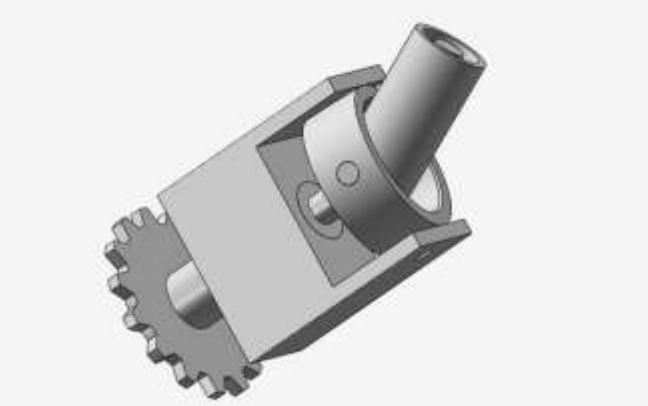


The third model is simply a dowel cut in several lengths. Here I wanted the joints to be flexible enough to fold up, but also springy enough to automatically unfold into a fully extended wing. I glued pieces of cable tie strap into slots sawed in the ends of the dowels. The arm did unfold spontaneously, but not as completely as I'd hoped, as the plastic stays slightly bent.

And the fourth model is a modified Guillow glider. To give more length, I joined two Guillow wings end-to-end, resulting in a 24" span. Then I cut the wings and jointed the sections back together. The joints are hinged and sprung with rubber bands. The bending moments at the joints were obvious, so 3 bands were added at the shoulder, 2 the elbow, and one for the wrist. The glider flew well after that adjustment. In this version, extending the wing is automatic - they pop out neatly by the rubber tension. Retraction, however, remains unsolved.

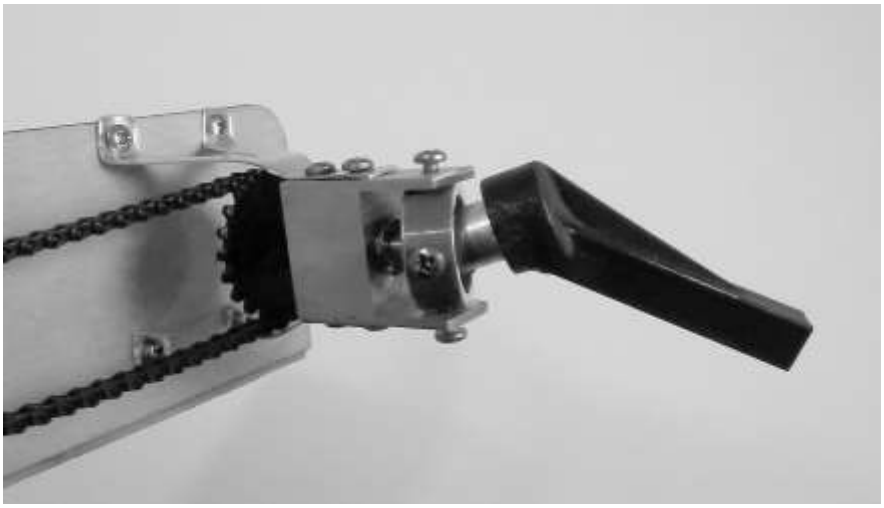


Schmid ornithopter mechanism. The sprocket turns a bent rod, which produces the basic circular motion of the wings.



The gimbal mechanism is driven by the bent rod and controls the angle of incidence as the wing moves around in a circle.

The author's reconstruction of the Schmid mechanism used an electric motor and a miniature plastic drive chain.



This close-up view shows the gimbal mechanism that helps direct the movement of the wing. Search "Adalbert Schmid" on Youtube if you would like to see it in action.

Payload-Lifting Ornithopter Contest

Do you have what it takes to build a huge ornithopter capable of lifting a bowling ball high in the air? Check out contest rules and information on our web site:

www.ornithopter.org

There is a $1000 cash prize.

Flapping Wings

Published by:
The Ornithopter Society
118 Callodine Avenue
Buffalo NY 14226

Please Join Us:
Your donations help pay for student research grants, competitions, and our education effort through the newsletter and website. To join the Ornithopter Society, send a check or money order, or sign up at www.ornithopter.org. Thank you for your support.

Suggested Donations:
Student: $12.95
Hobbyist: $24.95
Professional: $49.95