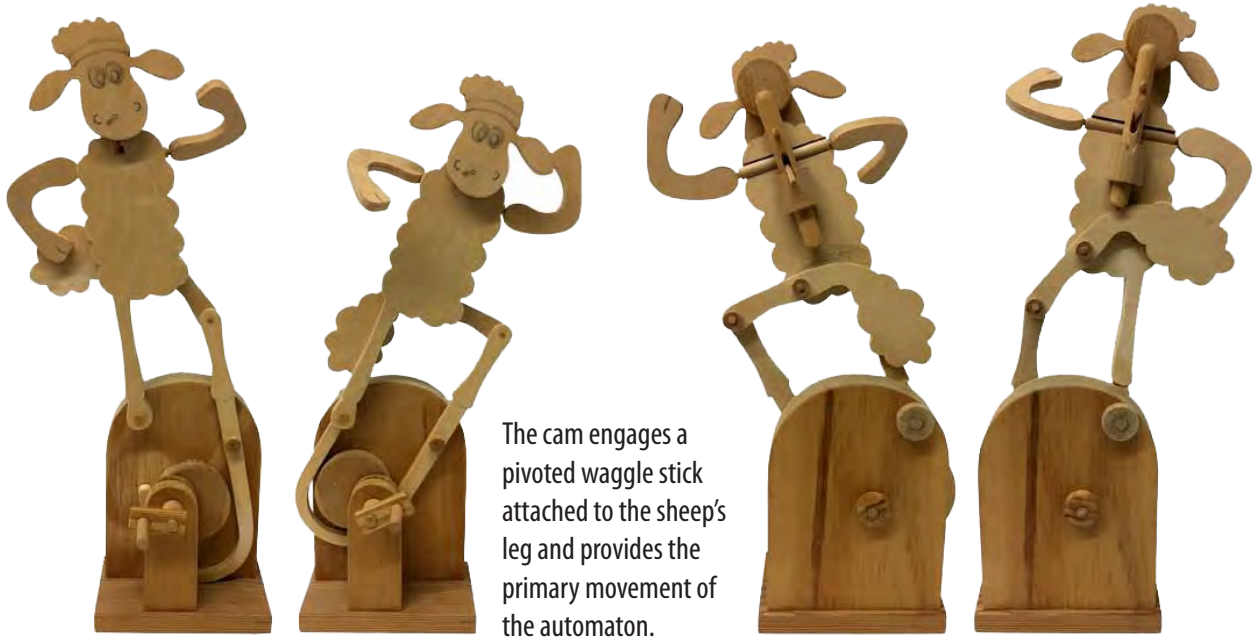
AUTOMATA FOR BEGINNERS

Waggle sticks

by Sarah Reast • Llanbrynmair, Wales, UK • Photos by the author

A waggle stick is one of the most useful bits of an automaton's mechanism. This is a stick of some sort and it waggles. In strict engineering terms it is a lever and a linkage, but if your business is to bring an inanimate object to life, then strict engineering terms don't quite cut it.

For the purpose of this article, we are seeking to achieve a side-to-side movement only. This is a reciprocal movement but I prefer the word "waggle." Precisely calculated and defined arrangements are necessary for robots but not always for automata. In many of my articles, I make the case for a unique language for our world. This is not meant as a denigration or corruption of engineering, but rather a way of adding character and quirk in order to entertain and surprise.

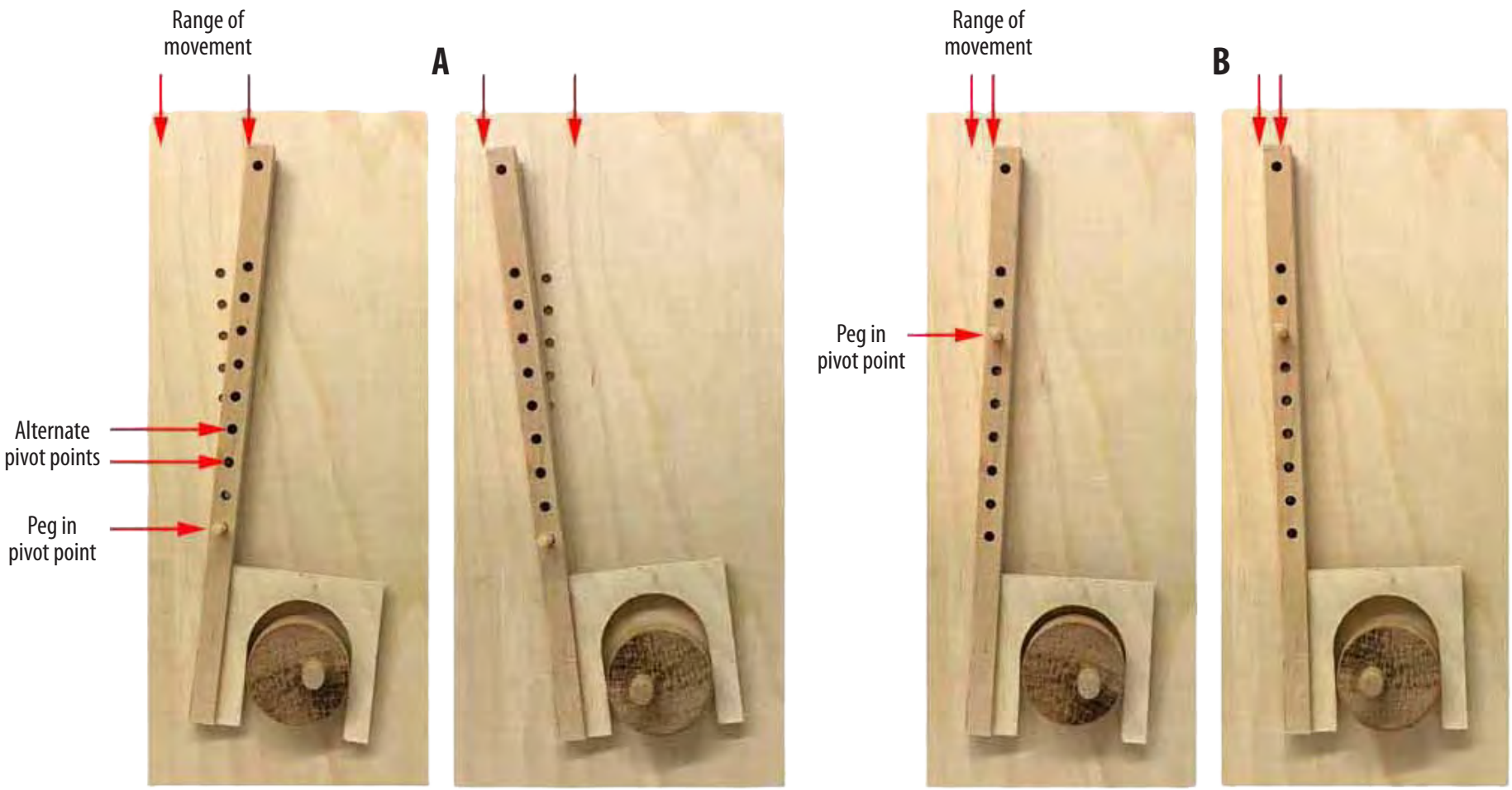


The cam engages a pivoted waggle stick attached to the sheep's leg and provides the primary movement of the automaton.

1. Sheep exercising.

In a simple automaton, a waggle stick is often used as the central core mechanism from which other linkages may pivot. It will often be articulated by a cam, as seen in **photo 1**, depicting an exercising sheep.

The extent of the stick's waggle will depend on the location of the



2. Range of movement.

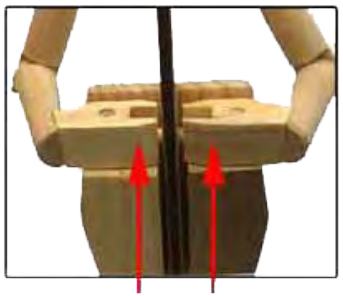
pivot and the nature of the cam. If you want to use a waggle stick, it is useful to start with a test rig from which you can make some estimations. I use the word *estimations* rather than *calculations* because you shouldn't expect a waggle stick to behave entirely accurately. There can be lag and/or bounce caused at various points that can restrict or exaggerate its effect—more about that later.

In a test rig you start with known quantities, such as the size of the available cam, the height of the model, or the range of movement you need out of it, and you allow experimentation for the bits you don't know. In my rig in **photo 2**, I have provided a choice of different pivot points to find out what the range of movement might be. As you can see, the closer the waggle stick's pivot is to the cam,

the greater the movement will be at the top of the stick.

Note that the distance your cam can push is shown by the arrows outside the red circle in **photo 3**. Both the size of the cam and the position of the hole for the drive-shaft are what count.

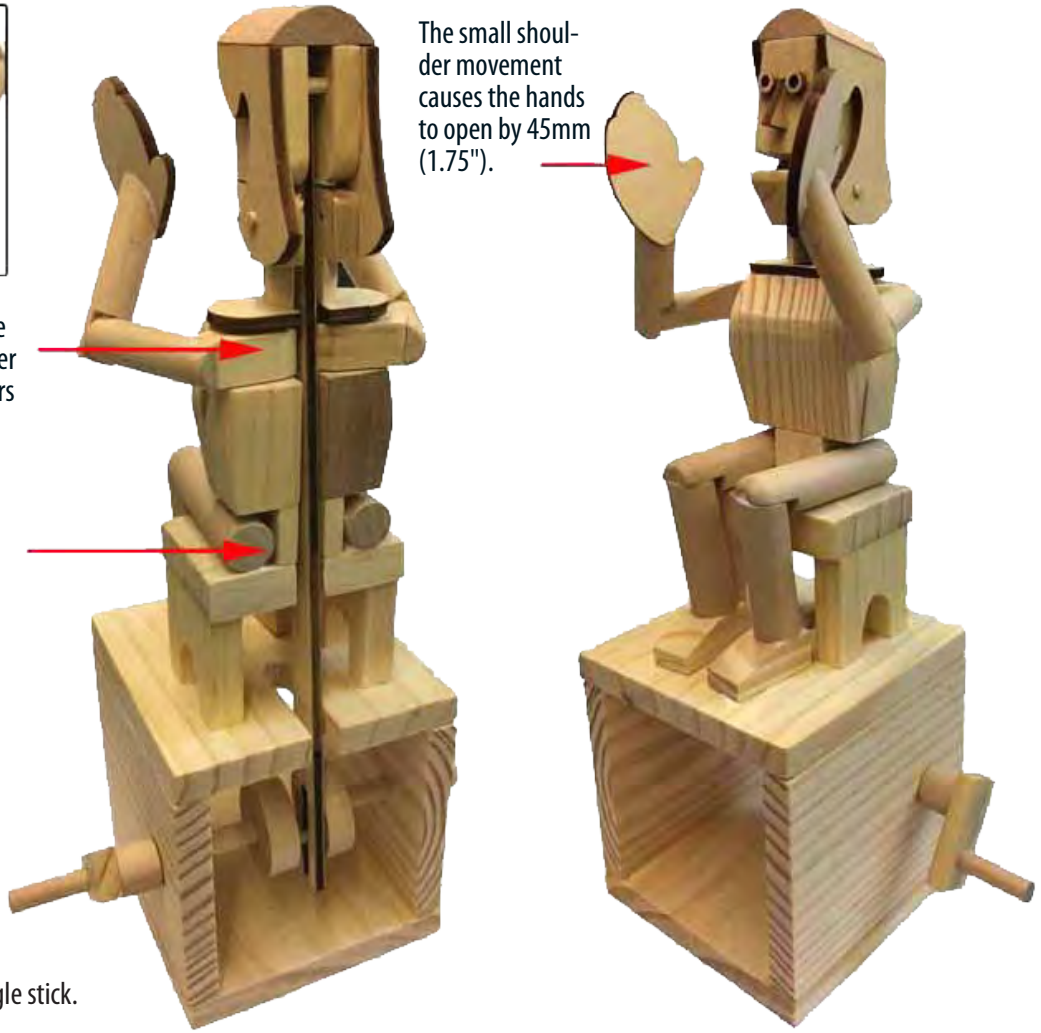
3. Effective cam movement.



A peg goes through the waggle stick, inside a groove in shoulder pieces. This moves the shoulders by 7mm (.275").

Waggle stick pivots at the hips

The small shoulder movement causes the hands to open by 45mm (1.75").



4. Subtle movement of the waggle stick.

Subtle movement

You would be forgiven for thinking that the tiny movement achieved in test **B** in **photo 2** is hardly worth the bother. However, a tiny movement can go a long way, as seen in our clapping *Happy Hands* model in **photo 4**. The extent of the movement achieved by the combination of the cam, waggle stick, and pivot point is tiny, but it will still create significant effect when the long arms and hands are added.

Lag and bounce

Lag and bounce can happen when there is slack in the mechanism. When we design an automaton at Timberkits, we have to imagine many customers with

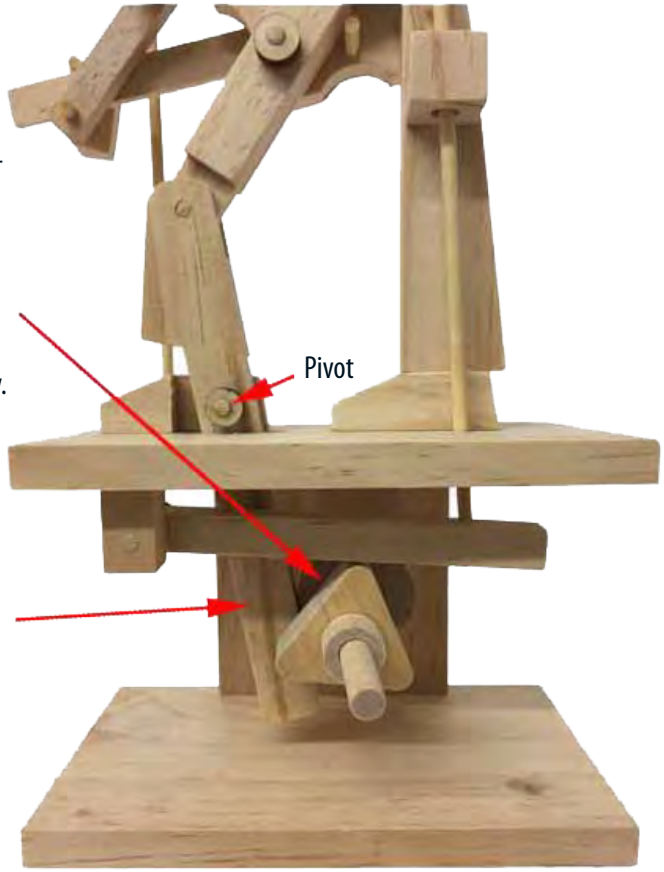
varying abilities building our kits, and not all of the builders will be precise and tidy in their construction. It is easier for a model to accommodate a bit of accidental slack than for it to cope with a tight bind, so we tend to build-in the slack.

Slack can mean that the cam will spend some time not actually pushing or pulling anything, as it takes up the spare space available. We call this "lost motion." During lost motion, the mechanism may lag or delay, or it may bounce if there is enough energy or momentum behind it. This can often be turned to our advantage, as it creates a less regular and more organic movement (**photo 5**).

I hope you have enjoyed these ideas on the subject of waggling. My next article will be about wiggling—from characters to critters! I kid you not. AM

Because the waggle stick is not contained or constrained by any other structure, it cannot bind. In fact, it can bounce if the model is operated at speed, thereby giving the guitarist a very jaunty rhythm.

The round cam (behind the triangular cam) pushes the waggle stick from side to side. The waggle stick is integral with the lower leg and is pivoted through the foot, so it pushes the knee joint up and rocks the whole body.



For most of the round cam's revolution, it is not doing anything, so this is lost motion. This allows the more rapid arm-strumming action, operated by the triangular cam in front, to have a contrasting rhythm.

5. Putting lost motion to good use.

Contacting Sarah

If you have questions or comments for Sarah Reast, you can write to her in care of *Automata Magazine*: *automatamag@comcast.net*. Just put "Message for Sarah" in the subject line.

Sarah is the designer and director of Timberkits Ltd., which creates wooden mechanical models sold in kit form. To learn more about her company, visit *https://www.timberkits.com/*.