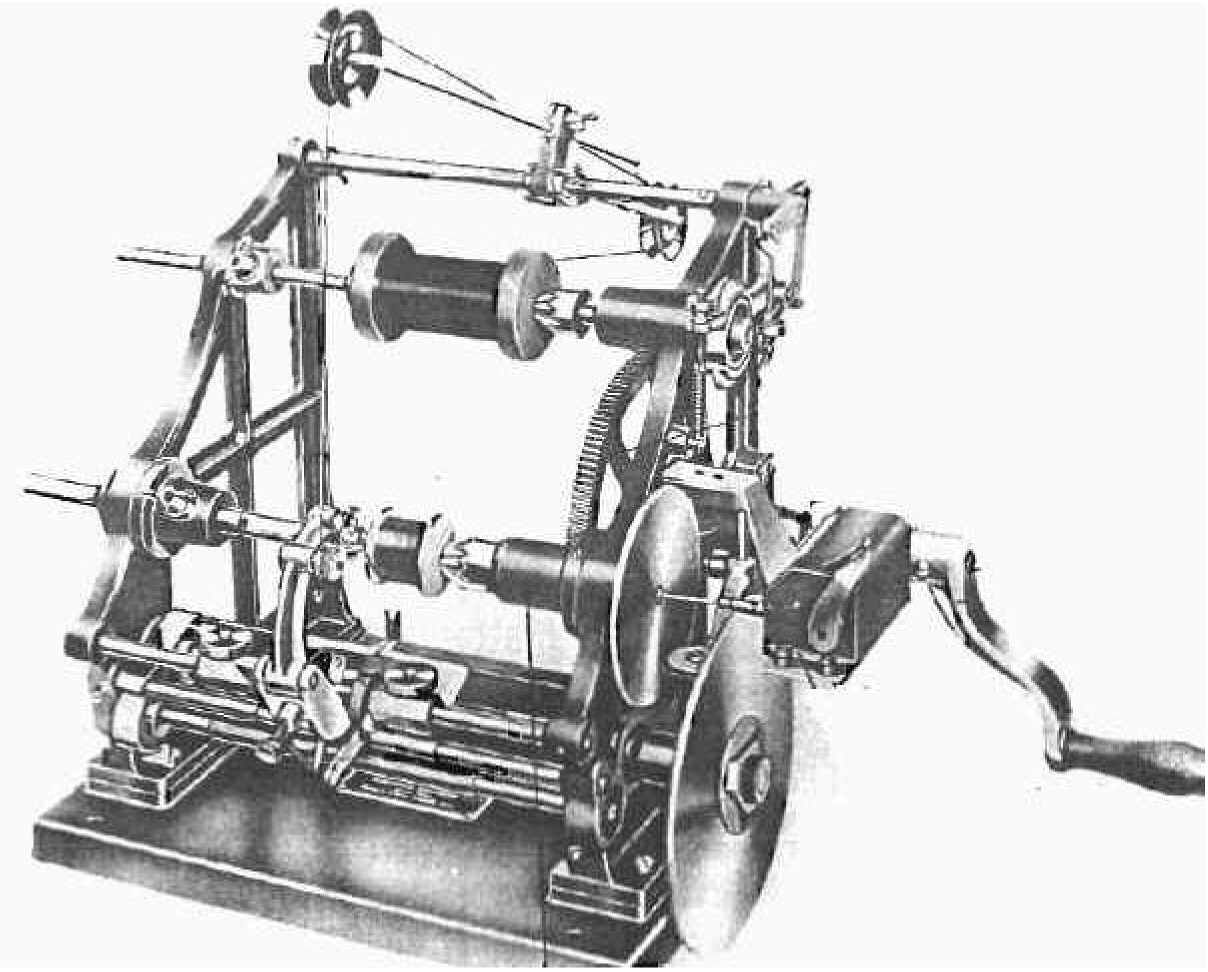
The AVO – Douglas coil winder No 1 and No 3

Even if you do not actually have one of these, it is worth looking at how this device is constructed, possibly because you would like to design a coil winder yourself.
The ones in question are for winding linear coils only, not wave winding. Many designs have been published in the past – some fall short in important respects.



Requirements

There are three main criteria to be met:

- We need to cover sizes from, say, 18 to 50. This is to determine the feed rate, and needs to be stepless.
- It is necessary to control the wire tension, particularly for the smaller sizes, or the wire will stretch or break. Many published designs do not have this facility, or do it badly.
- Reversing the feed at each end should be instant. Some of the designs are very complex in this way – the AVO is a simple but effective design, as can be seen.

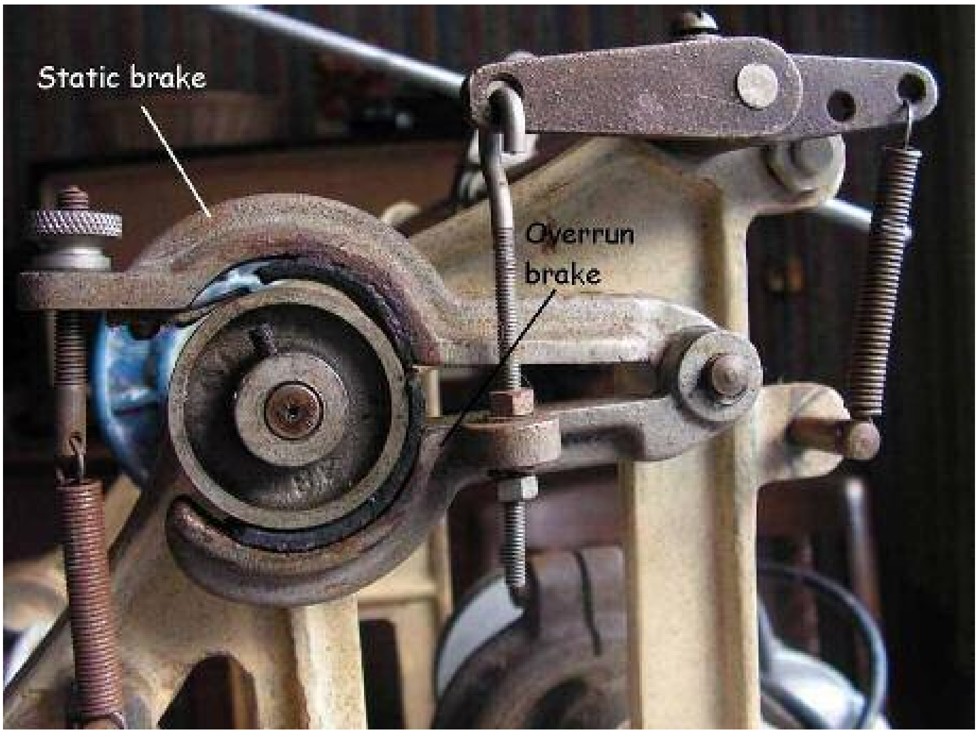
Design

Although there is a manual available, this naturally assumes that the machine is in your possession, so some of the parts and their operation are not easily seen. We will adhere to the terminology and numbers on the parts.

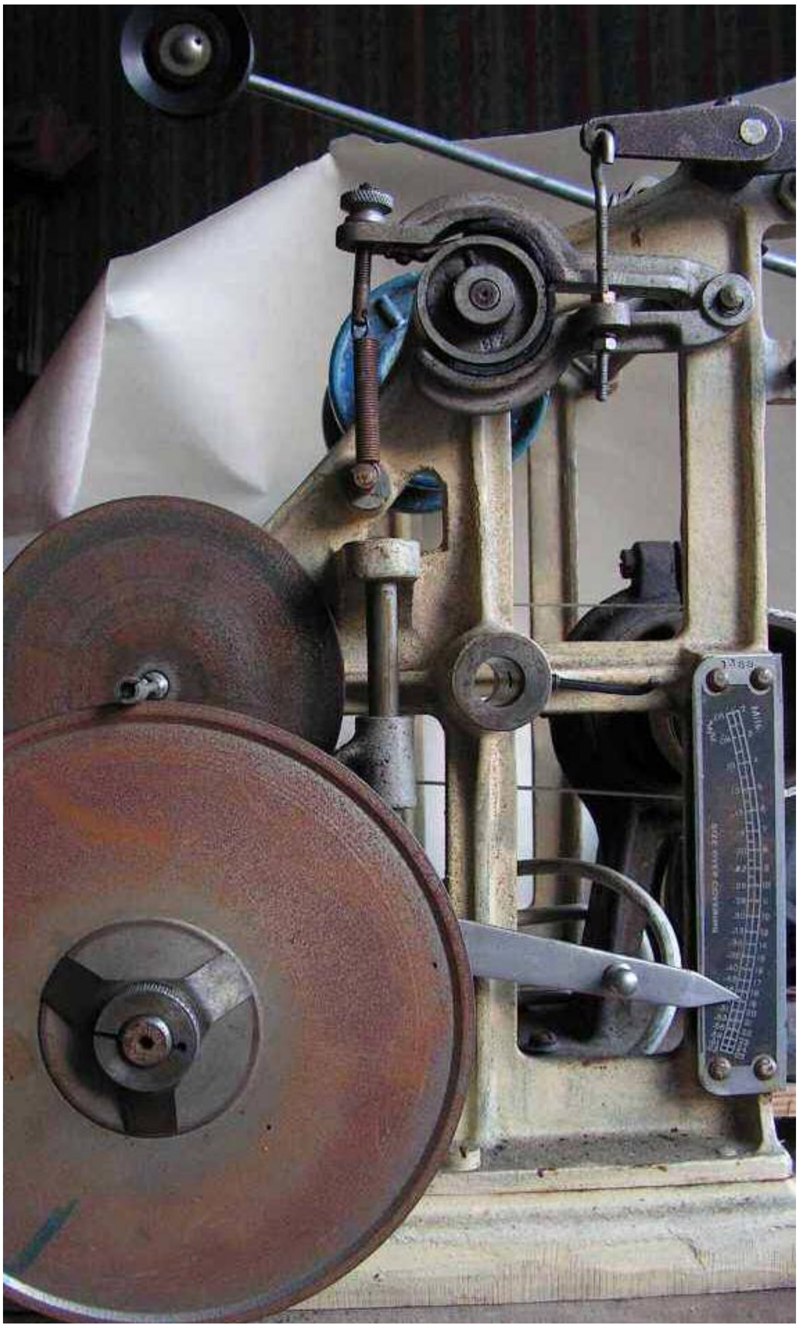
Basic construction

The machine is made with two cast iron end-frames bolted on to a massive iron baseplate. Some spindles have ball races and some of the various fixed longitudinal bars are retained by Allen screws on the end-frames.

Reel spindle



This has an adjustable cone on the left, and the fixed right-hand side runs on ballraces and has a brake drum on the outer end-frame.
There are two brake shoes mounted on a stud: These are lined with friction material. The upper one has adjustable spring tension that is set depending on the wire size. The lower one is the overrun brake. On a square spindle across the frames is mounted an adjustable pulley that the wire goes over on its way to the wire guide. On the outer end on the spindle is a lever with a link connected to the lower brake shoe. If wire tension increases, the pulley and arm are pulled down, and the lower brake shoe is released. So that the pulley is held in the lifted position and the lower brake is engaged, there is a tension spring on the squared bar lever – this has two holes to adjust it for different wire sizes. Finally, there is another fixed pulley to use as well as the overrun brake pulley, for thicker wires.



Variable drive

The wire guide that traverses the wire back and forth has a leadscrew and nut – more on the details later, but to accomplish the wire sizes that we are talking about, a feed rate of from 0.025 to 0.002 needs to be used. As the leadscrew is 40 threads per inch – 0.025 pitch, then the variable gearing has to go from 1:1 for largest size, down to about 12:1 for the smallest ones.

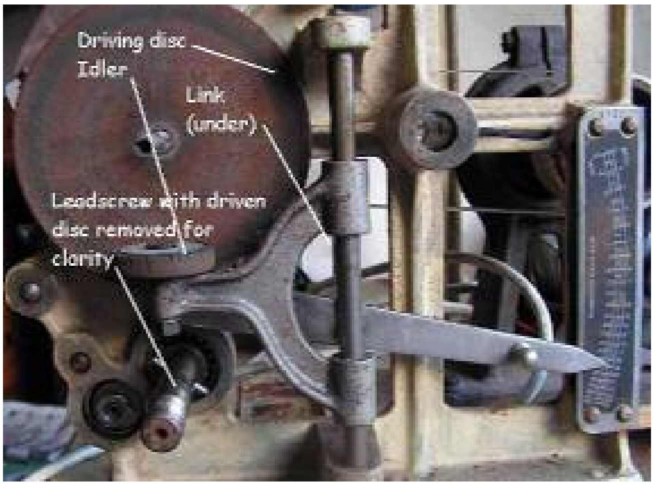
The variable ratio is accomplished by having a steel disc on the coil spindle and one on the leadscrew. These discs overlap, and an idler with a rubber tyre is interposed with its spindle vertical. By moving the idler from down up until the upper disc is on its smallest diameter and the lower disc at its largest, this gives the slowest ratio; moving the idler down towards the outside of the upper disc speeds it up.

As the top disc is 4 inches in diameter, the lower one 6.25 inches, and the distance between centres is 3.25 inches, the travel is from the distances on the Table 1.

The scale has an arm that moves the link carrying the idler so it can slide up and down; to ensure that the idler is free to follow the discs, the arm is allowed to rotate and the lower disc is spring loaded with a 3-sided leaf spring as shown, its boss has a slot to carry a pin on the end of the leadscrew.   Thus, the idler is gripped by the discs.

Lower disc	Upper disc	Ratio	Feed (inches)
3.000	0.250	12.000	0.0021
2.875	0.375	7.667	0.0033
2.750	0.500	5.500	0.0045
2.625	0.625	4.200	0.0060
2.500	0.750	3.333	0.0075
2.375	0.875	2.714	0.0092
2.250	1.000	2.250	0.0111
2.125	1.125	1.889	0.0132
2.000	1.250	1.600	0.0156
1.875	1.375	1.364	0.0183
1.750	1.500	1.167	0.0214
1.625	1.625	1.000	0.0250
1.500	1.750	0.857	0.0292
1.375	1.875	0.733	0.0341
1.250	2.000	0.625	0.0400

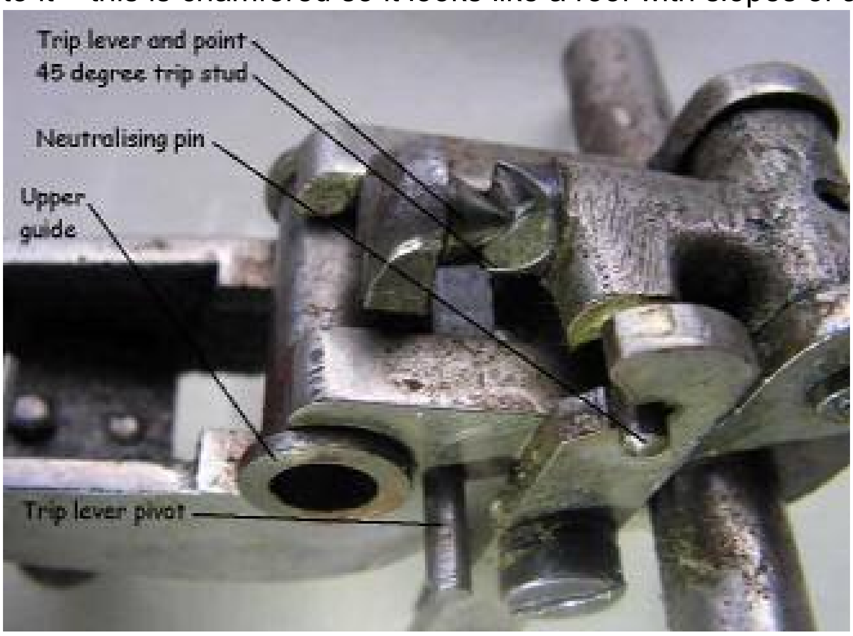
Table 1



Reversing mechanism

As stated, this needs to occur rapidly and cleanly.   The wire guide carriage travels on two fixed rails horizontally, the actual guide is pivoted on the carriage; a knurled screw can be set as how far the guide is lowered into position.   The guide is either a pair of pulleys or, optionally, a grooved plate. It falls by gravity and can be swung up out of the way of the coil.
One of the rails has the two end stops that are set to operate the reversing trip. These stops have knurled nuts for fine adjustment.
For the reversing, there are actually two identical leadscrews with a pair of spur gears attached to each left-hand end. This means that the screws rotate in opposite directions.
The half nut arm carries two half nuts that are freely pivoted on the carriage and can rotate about five degrees to engage with either leadscrew using the half nuts. It is possible for the nuts to just clear so they are free from both screws.

The trip mechanism is a simple and elegant device: The top of the half nut arm has a trip stud fixed to it – this is chamfered so it looks like a roof with slopes of about 45 degrees. It is mounted so that the ‘ridge’ is set at 45 degrees to the centre line = see pic.



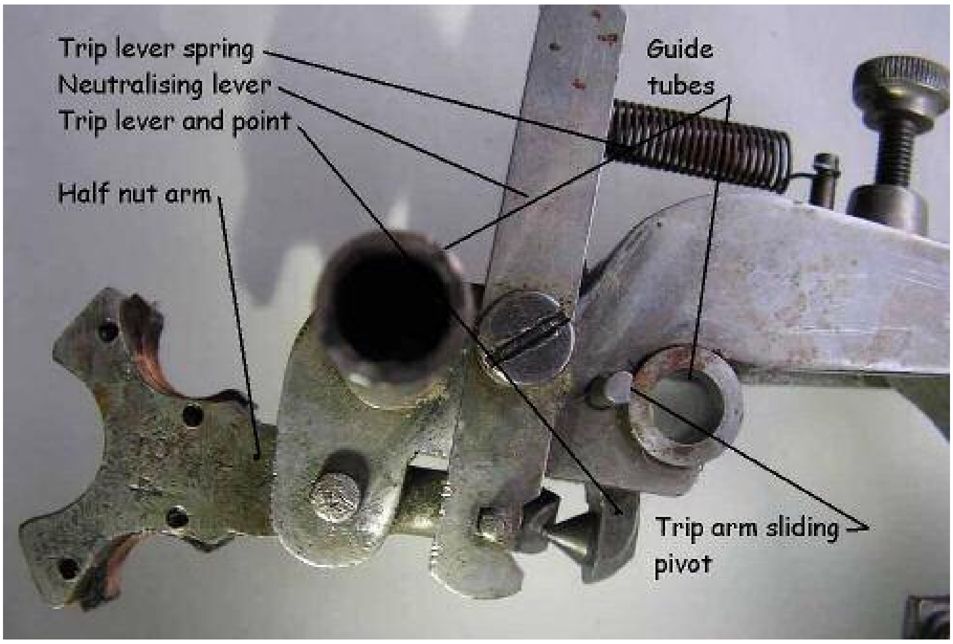
The only other part is the trip lever, pivoted on the carriage above the half nut arm, and can slide about ¼ inch in each direction as well as pivoting. It has a point that sits on the ‘roof’ of the trip stud, and is spring-loaded so the point bears on it.

This means that the trip lever point will press on one the half nuts so it engages with the leadscrew, and that the trip lever will be forced to one side of the carriage or the other.

The trip lever pivot projects so the end stops can push against and move it.
As the carriage is driven one way, the projecting trip lever pivot pushes it so the point approaches the ridge of the stud – as soon as it goes past the ridge, two things happen simultaneously:

(1) The point snaps the half nut arm to the opposite side, reversing the leadscrew.
(2) The point is pushed down the slope on the stud, so it travels to the opposite end of the carriage.

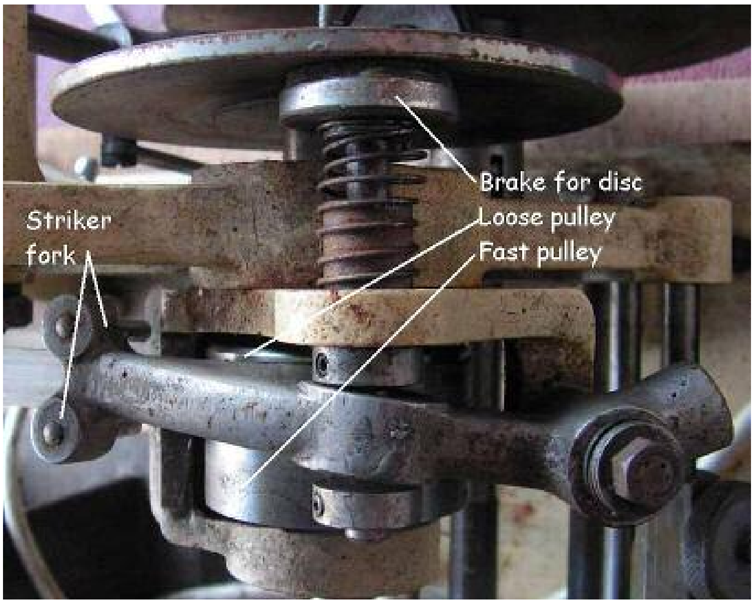
So, it can be seen that the trip lever can only remain at either end, and if the neutralising lever is not in use, the half nut arm can only engage fully with one of the leadscrews.



To allow the carriage to be slid without damaging the leadscrews or nuts, the neutralising lever is pushed up so the notch forces the half nut arm into the centre position.

Motor drive

A motor is mounted on a countershaft, with flat belts from the motor to countershaft, and from the countershaft to the coil spindle.
To allow the motor to start. there is a device known as a fast-and-loose pulley on the countershaft. This was a well known way of avoiding having to design a clutch; sadly, with the advent of the vee-belt, it could not be used.
The spindle has a pair of flat pulleys of identical sizes; the outer one is attached to the spindle, the other one is free to rotate.
The corresponding pulley on the countershaft is as wide as both pulleys together.
A striker fork has pins that straddle the belt, and a handle (shown removed) to allow the belt to be shifted from one pulley to the other.



The spring loaded pad prevents the inertia of the spindle failing to stop it dead.

Nowadays, you would probably use a universal motor and a triac speed control to do this.
The No 1 machine replaces all this with a large gearwheel with a handle engaging with a small one on the spindle, as the manual shows.

Thoughts on making a coil winder – in no particular order.

Obviously the end plates would not be cast. They would have to be fabricated, but maybe not to the original dimensions; in fact, the whole machine could be scaled down a little for my purposes.
If I used steel sheet/bar then various bosses could be brazed into position.
There is no need for the reel mechanism to be attached precisely to the rest of the device.   It could be a separate pair of bars attached to steel angle to form a base, and have two spacing rails from left to right.

The reel spindle could be made much lower. There would need to be ball races on the right hand side, likewise for the mandrel spindle. The left hand ends of these would have stationary spindles with a bronze bush and steel ball on the cones.
A threaded rod could be used for the idler carrier instead of the guide bar and link; we could have a crank handle on it and have a calibrated scale.
Instead of the leadscrews and carriage guides being tilted, it would save end-plate space to have the leadscrews horizontal. The centres of the mandrel and leadscrew would not be vertical than, and the idler pitch adjustment would have to follow this at an angle; not too much of a problem.
Brass tube would be used for the carriage guides, and the carriage sides could be 3mm steel with flanges made from washers silver soldered on to the guides and screwed to the carriage sides. The trip and nut levers would be mild steel bar.
I would have to screw-cut the 40 TPI leadscrews, and look for a pair of gears before deciding on the distance between centres.