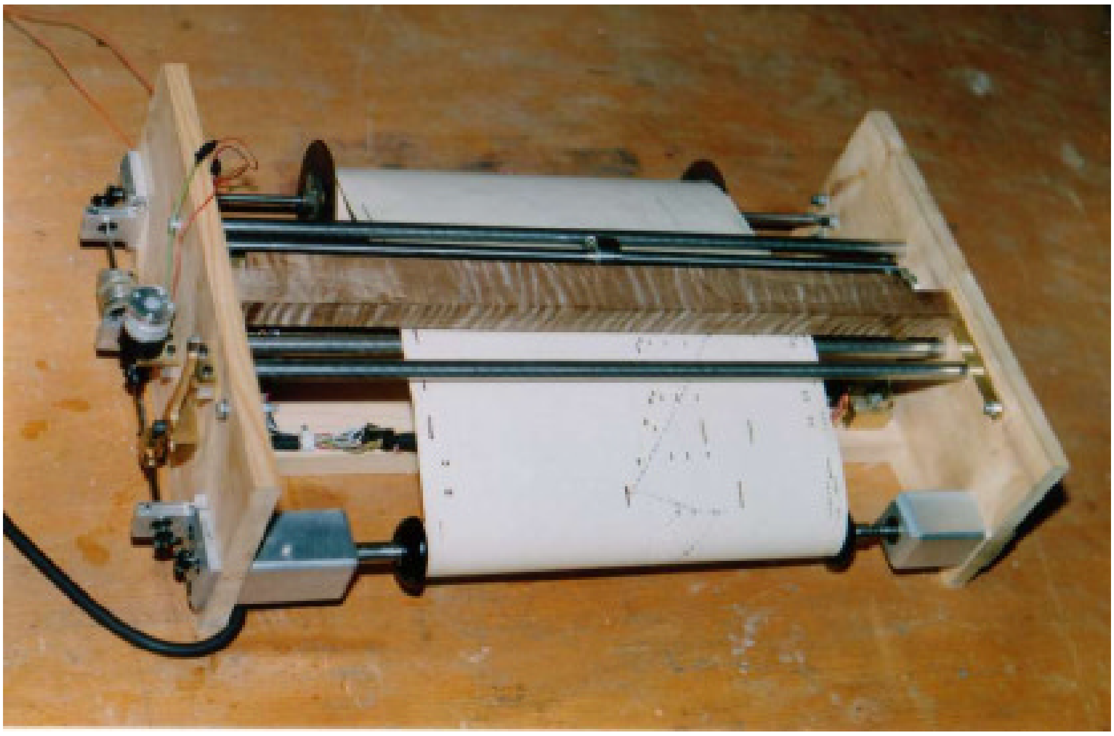
ROLL SCANNER DESIGN

Draft description



By Leonardo Perretti

This is a draft description of the transport part of the roll scanner I have developed recently.
The device is currently under testing; most of the tests I have performed were positive; anyway, some parts are known to be in need of modification; some other parts will be modified so as to improve their functionality.

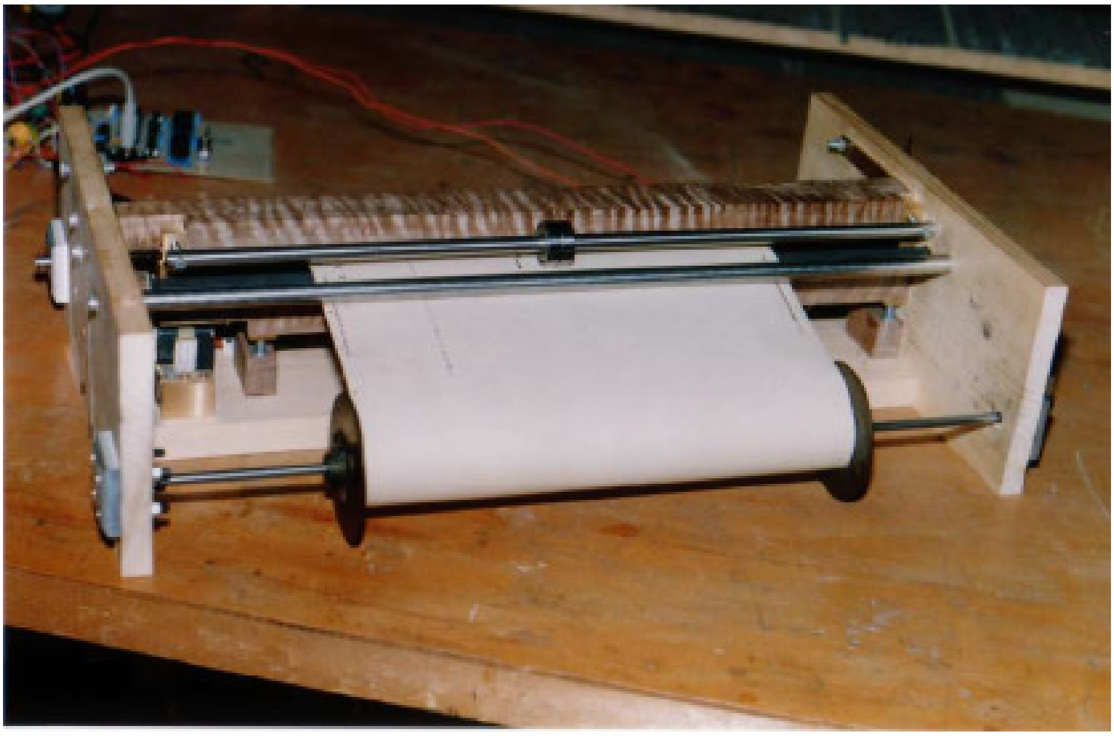


Fig. 1

The Fig.1 shows the entire device with a roll in place. The basical frame is made with two wooden plates at sides, joint by another narrower wooden table at base.
The bar at top keeps the roll adherent to the sensors and serves as a support for the pinching bar (see below for further details). It can be raised and rotated back, so as to mount the roll properly. In the Fig. 2, showing the device seen from top, it is rotated, so the central part of the scanner can be seen.

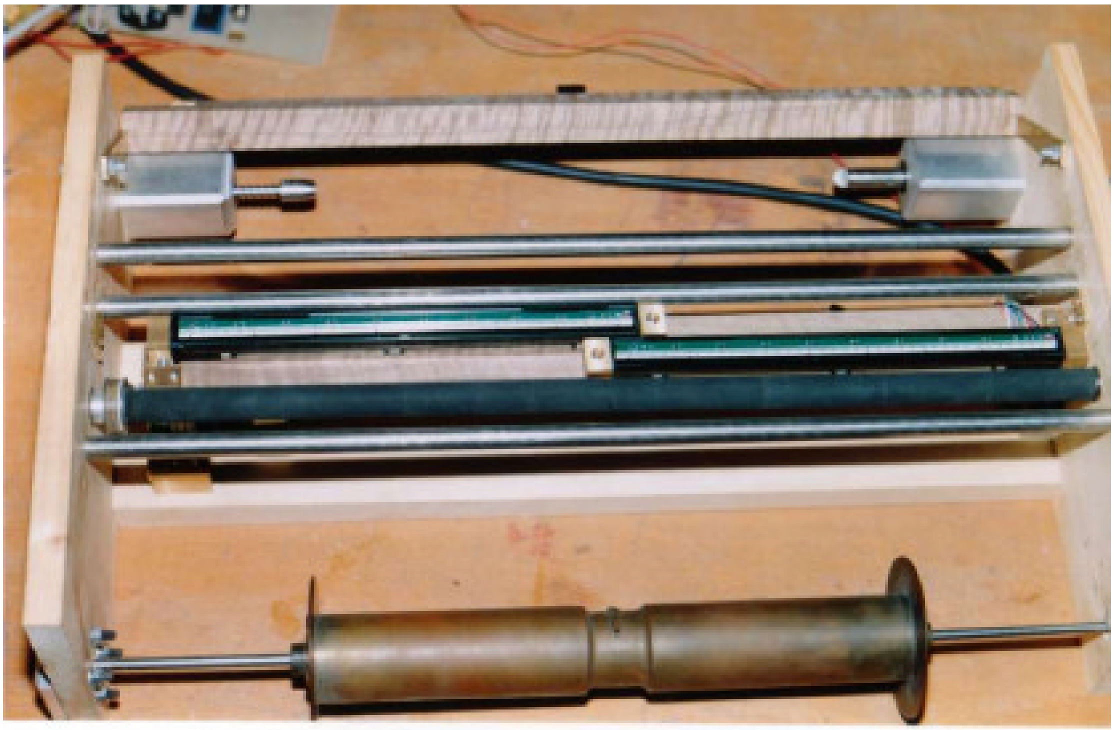


Fig. 2

At center of the scanner, upon the base table, there is a support for the sensors; it is placed upon two small blocks with screws and springs, so that sensors’ heigth can be regulated from under the base. In Fig. 3, near the stepper motor, one of the blocks can be seen, see also Fig. 1.

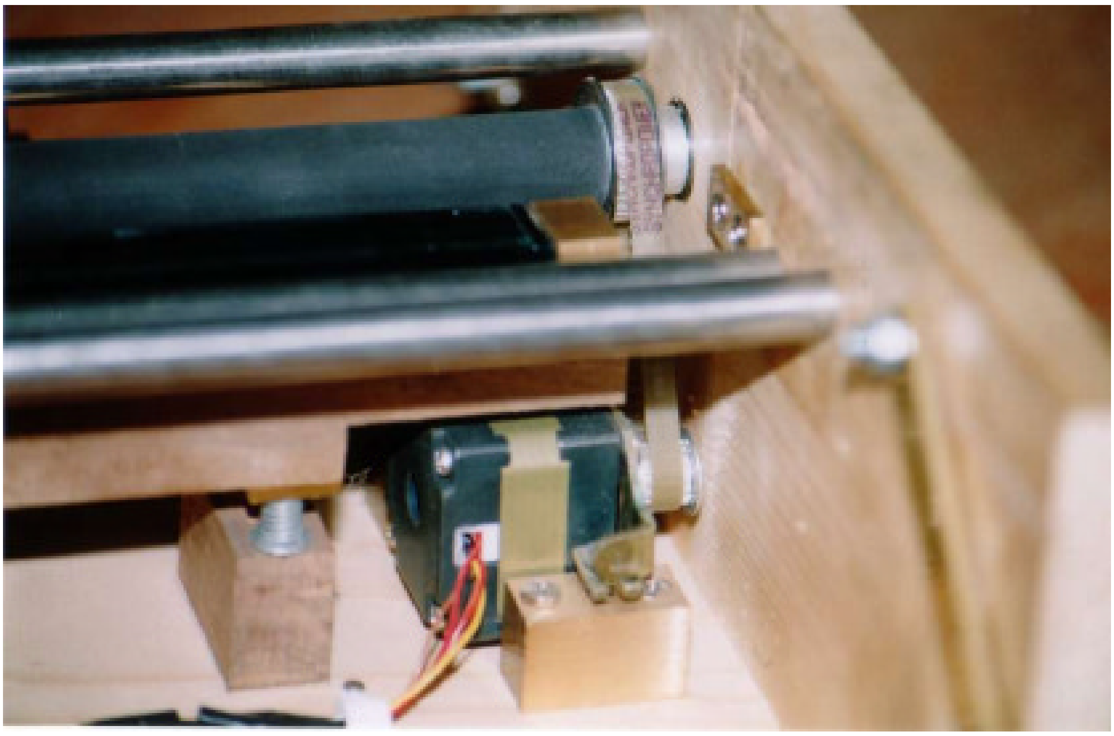


Fig. 3

Between the base table and the sensor support, there is a space that will be used to host the electronic boards; they are currently placed out of the device, for testing purpose.
On top of their support, two A4 sensors are accomodated, staggered. Their ends toward the center are held by brass fixed blocks, while their lateral edges are held by two brass devices with screw and spring for horizontal alignment (see Fig. 4 for details).

Also, Fig. 3 and 4 show the stepper motor for the capstan, and its gears.
The capstan is made with a stainless steel rod, diameter 12 mm., coated with rubber, extending from side to side and mounted on ball-bearings.
The stepper motor has a 16 teeth pulley, and the capstan a 32 teeth pulley, linked with a synchronous belt, so rotational movement of the capstan is reduced to half that of stepper’s axis. The stepper is 200 steps per turn; if used in half-step mode it could drive the capstan at 400 steps, which, reduced by the pulley and belt system, gives 800 steps per turn. Since the total diameter of the capstan is 17 mm., the best obtainable resolution is (17*PI)/800=0.06676 mm. (0.00263 in.) per step.

Parallel to the capstan, beyond the sensors, there is a steel rod, upon which the roll passes, coming from the feed spool. It assures that the paper is kept plain when passing over the sensors. Two more rods, placed externally and slightly higher with respect to the capstan and its counterpart rod, help in keeping the paper in the correct position when flowing over the sensors.

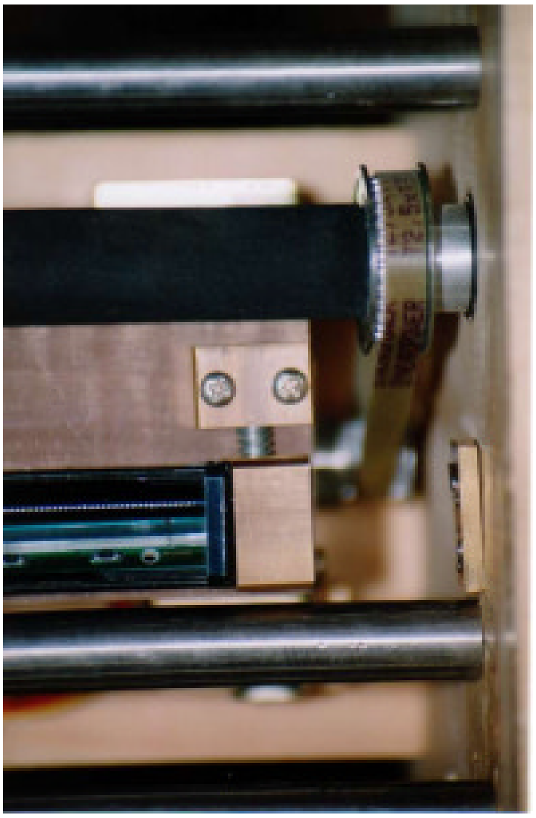


Fig. 4

The above mentioned wooden top bar (the bar with striped appearence due to the natural marbling of the wood) was originally thought to host the lamps and support the pinching bar; in this version, I use the CIS leds for illumination, so no external lamp is used; I will add it in the next improvement.
The bar is kept in place by two brass levers pivoted to the side plates at some distance, so it can be raised and rotated back toward the feed spool. In Fig. 1 and 5 it is “closed”; in Fig. 2 it is “opened”.
Attached to the wooden bar, on the side toward the take-up spool, there is the pinching assembly. It is made with a steel rod in which two ball-bearings are inserted. The steel rod is joint to the wooden bar by two screws with springs, screwed to brass blocks, which are pivoted at sides of the wooden bar (see Fig. 6). When in “closed” position, the wooden bar leans on two brass stoppers (see Fig. 4, right-center); the pinch bar, being pivoted by the brass blockets, can hang on the capstan, and the weight of the pinching assembly keeps the paper pressed to the capstan by the ball-bearings. The screws and springs allow to align the steel bar with the capstan.

I would have more to say about this detail. In the currens scheme, the pressing ball-bearings could be swept along the steel bar, and placed wherever you want. The original idea, indeed, was to use four or five rollers, equally distributed along the roll width. This didn’t work, as even a small evennes of the roll caused one or more rollers to loose from the capstan, so the paper steered randomly; this was because the rollers are constrained on the same line, being attached to the same rod. At the end, I was convinced by Spencer Chase’s idea of using only one roller at the center.
Anyway, I am still thinking that more rollers are better, mainly because they would distribute the grabbing force of the capstan in several points, then the risk of shifting or damage to the roll is minimized. The solution to this might be, I think, making each roller undependent from the others. If each roller is attached to a short horizontal lever, oriented in the advancement direction of the paper roll, it could float vertically regardless of other rollers’ position (except for the horizontal alignment to the capstan), so mantaining its adherence to the paper. I will try this soon.

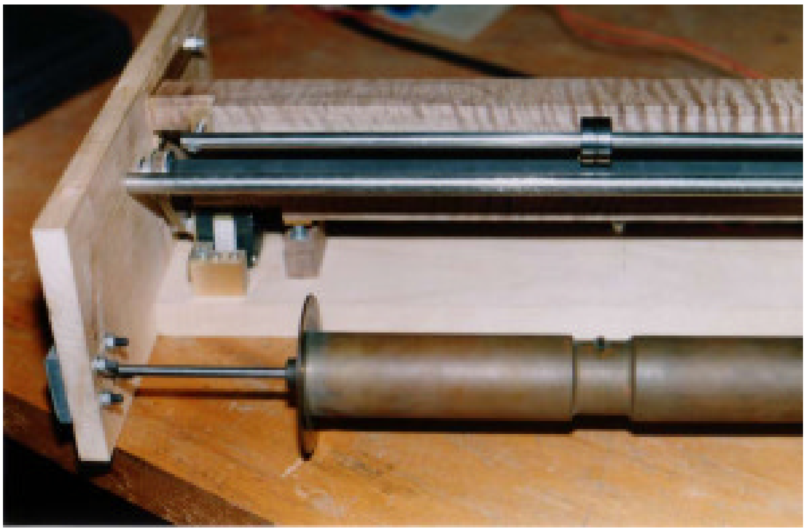


Fig. 5

Fig. 6

The take-up spool is reused from an old player piano. The feed spool holders are self-explanatory, see Fig. 7 and 8. They are adapters for the standard width rolls (11.25").
I am planning to modify these adapters, providing them with a sort of bajonet-joint system, so that different adapters could be replaced with minimum effort when needed.

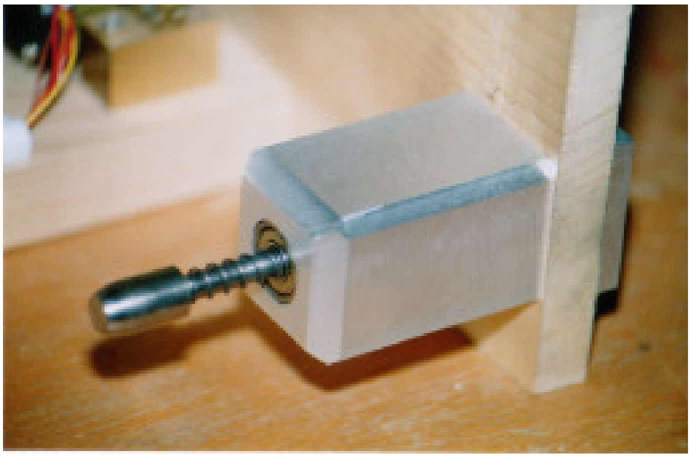


Fig. 7

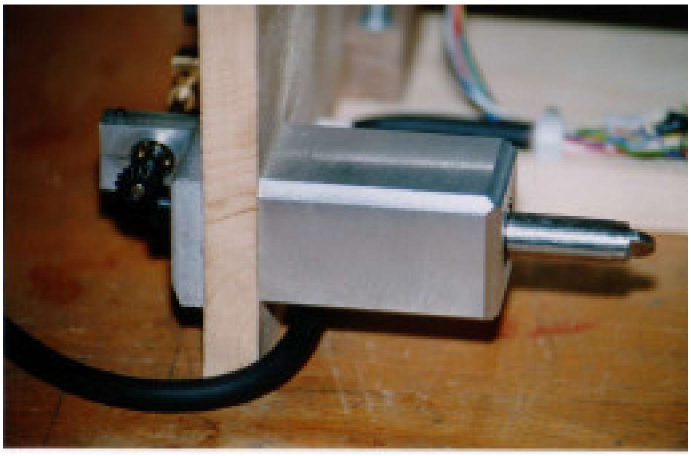


Fig. 8

Figure 9 shows the mechanism for the take-up spool action and for rewinding.
It is placed on one of the sides, externally.
It is based on a gear shaft, extending from the edge of the take-up spool axis to the edge of the feed spool. Each of such edges has conical gears, as well as the edges of the gear shaft. At the center of the shaft, two more conical gears can engage it, alternatively, with the axis of the motor. This is a small motor with built-in gear train, which reduces the speed to 80 rpm. The shaft is held in place by three supports with ball-bearings.
Near the motor, a lever allows to shift the shaft toward one edge or the other.

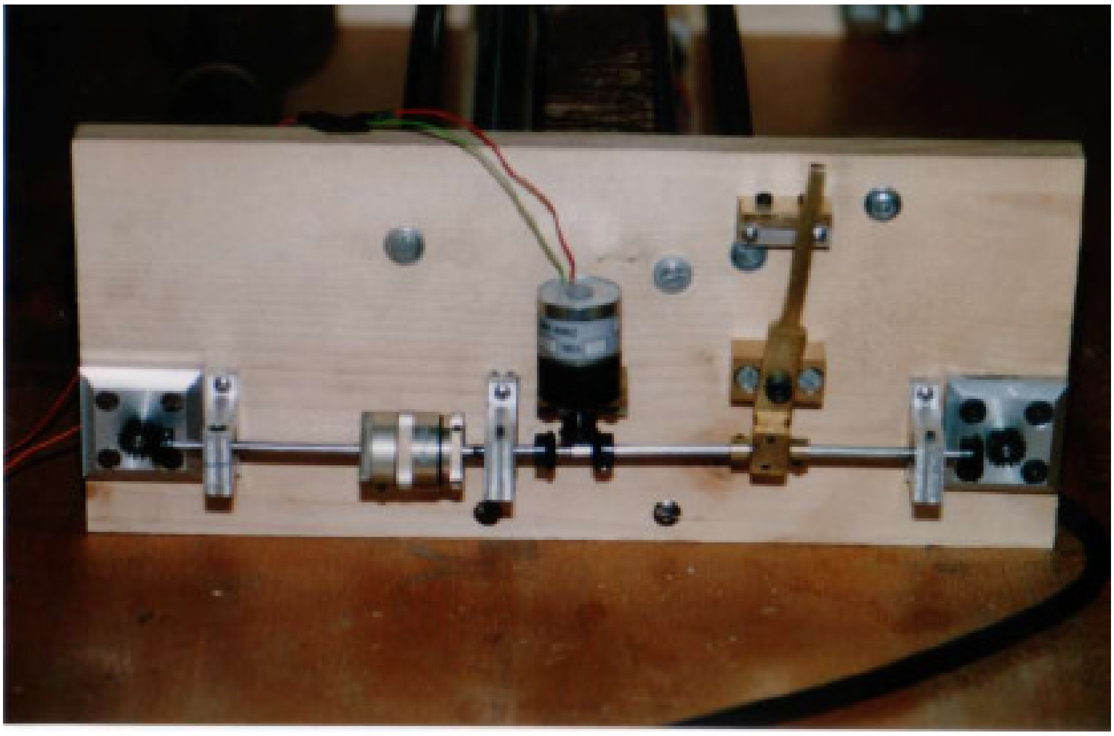


Fig. 9

When the lever moves the shaft toward the take-up spool, the conical gear at its end is engaged, while the one at feed spool's edge is disengaged.

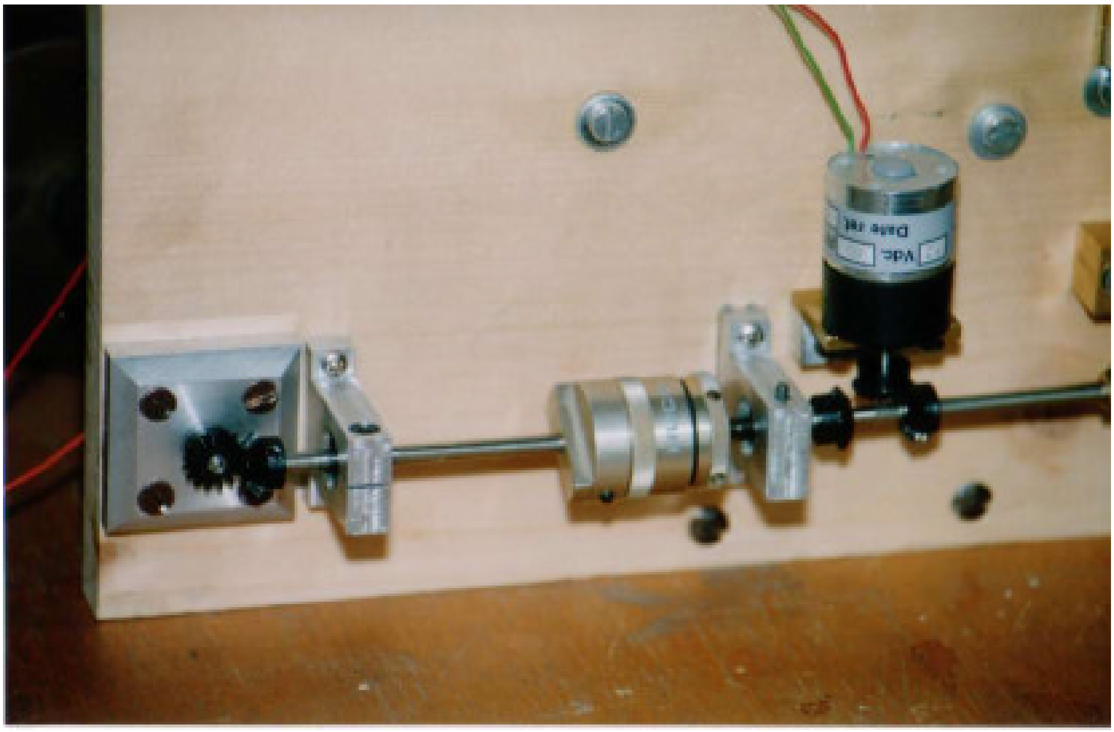


Fig. 10

On this side, the shaft is interrupted by a small mechanical clutch (the small cylinder near the center of Fig. 10), by which the transmitted force of the motor can be regulated. This allows to apply a small tension to the paper, so that the roll could gently wind around the take-up spool. The clutch has a regulating ring, that allows to limit the transmitted energy, even to small amounts, as needed.

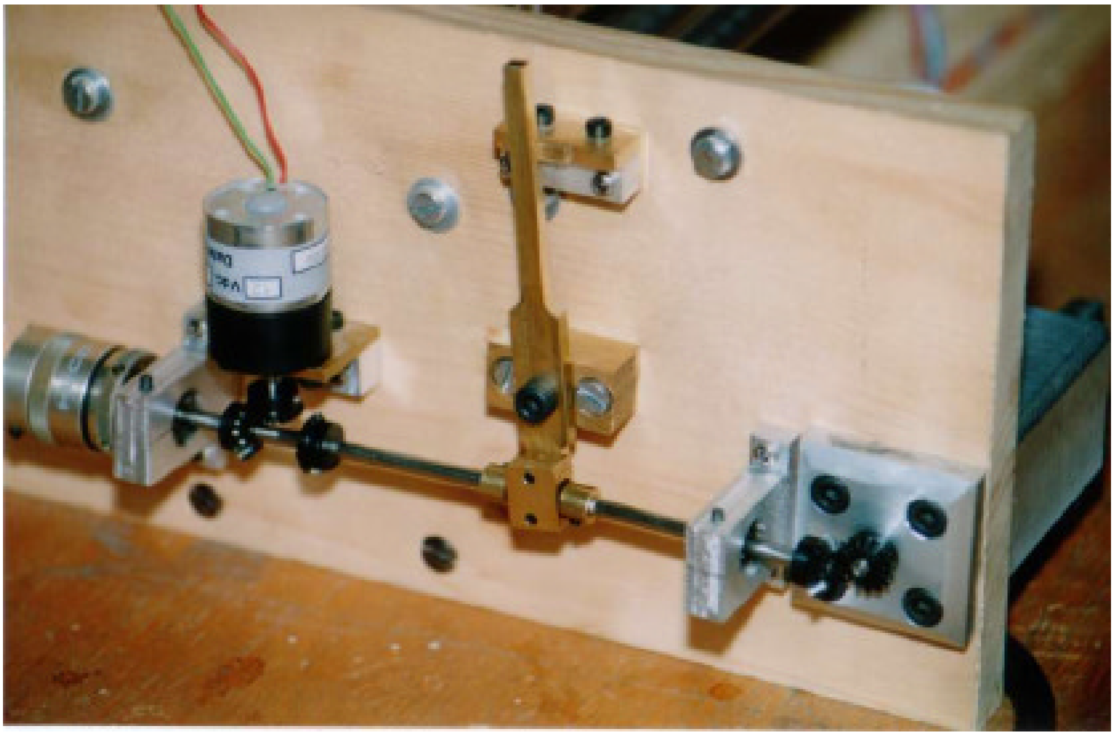


Fig. 11

Fig. 11 shows a detail of the other half of the shaft, with the lever. When the lever moves the shaft toward this side, the feed spool is engaged, the motor reverses its motion (manually, for now, by a switch), and the roll can be rewound.

The scanner is currently managed by the “CIS driver” board, whose description can be found at the IAMMP site. This board , in turn, is driven by a program I have developed for Macintosh only. At date, it can scan the rolls and store the scanned data in files, in compressed format.

For comments, suggestions etc., please drop an e-mail to:
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