

8

A Low Cost Treadmill for Experimental Animals¹

W. B. KOUWENHOVEN, T. E. STARZL AND B. BAKER. *From the Departments of Engineering and Surgery, The Johns Hopkins University, Baltimore, Maryland*

AMONG PHYSIOLOGISTS in recent years, there has been a growing interest in the adaptive mechanisms of the normal or altered experimental animal to conditions of exertional stress. Such studies depend upon accurate assessment and reduplication of exercise conditions in the same or different animals. The treadmill, in which the parameters of travel rate, incline angle, and time can be controlled, has come to be a standard method of exercise measurement.

Because most treadmills used for animal investigation are designed to accommodate human subjects as well, these instruments are usually large, expensive, and beyond the spatial or financial means of a small research unit. In the course of work in this laboratory a simple, inexpensive, small treadmill has been developed for use with dogs or other small animals. This treadmill has a continuously variable speed range of .8 to 7 mph, and readily accommodates dogs weighing from 5 to 25 kg. It has been used with satisfaction for many hundreds of hours, and because of the instrument's utility it was thought that it might be of value to present the construction in some detail.

THE FRAME

The principal dimensions of the frame are shown in fig. 1. A 1½"-wooden plank, 5' long and 14" wide, forms the base of the treadmill. To it are attached the motor and vertical supports of the frame. The supports consist of 14" pieces of ½" x 2" strap iron, one at each corner, each of which is reinforced by a 45° angle brace which runs to the base. At the driving end these braces are made of ½" x 1" strap iron, and at the other end consist of ½" eye to eye turnbuckles which are also useful for effecting fine changes in frame alignment.

Mounted on the vertical supports, one at each end, are two 8" diameter coned and flanged pulleys on a 1½" shaft, and on 54" centers. These pulleys run in ½" ball bearings. Completing the frame are two 56" pieces of ½" x 2" strap iron, one on each side, which extend to and are bolted into the tops of the vertical supports. To prevent bowing, these side pieces are connected with two strips of ½" x 1"

strap iron at each side of the mid-point. Mounted in these side pieces are seven spaced rollers which furnish support for the weight of the animal. The rollers are made of 2" diameter pieces of pipe on ½" diameter shafts. All pulley and roller shafts turn in ball bearings.

For running surface, a ½" continuous leather belt was employed, 11 feet in length and 11½" wide. Before the pulleys and rollers were mounted the belt was placed in position around them, and the unit then assembled. To control belt tension two adjustable idler rollers, of the same type as the other rollers were placed on the under surface of the belt—mounted on four additional ½" x 2" supports. Aside from permitting adjustment of

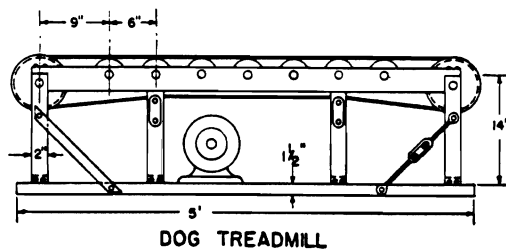


FIG. 1. Construction details of animal treadmill.

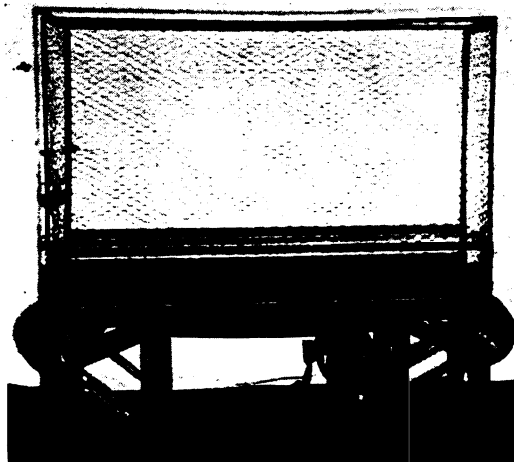


FIG. 2. Treadmill showing chain drive and cage (chain guard removed).

Received for publication June 14, 1954.

¹ Aided by a grant from the Public Health Service.

REPRINTED FROM
CENTRAL JOURNAL

belt tension, the idler rollers elevate the belt sufficiently to allow room for the drive motor.

THE DRIVE

The drive motor is mounted on the base, beneath the running belt, figure 1. Because this laboratory is supplied with 60 cycle AC current, the simpler and cheaper variable speed direct current motor could not be used. Instead, a $\frac{1}{4}$ -horse power, 1750 rpm, 60 cycle AC motor with a variable speed Master Speedranger drive was chosen. Speed is adjusted with a small calibrated hand wheel mounted on top of the drive housing. The drive shaft of the motor is attached to the shaft of the 8-inch pulley by means of a chain and sprocket connection, which is covered with a guard. In practice, this power source has given the full speed range with no demonstrable loss of torque.

THE CAGE

A light cage was mounted upon the frame, 36" in height, 14" wide and 54" long. This was constructed of an angle iron ($\frac{1}{2} \times \frac{1}{2} \times \frac{1}{8}$ ") skeleton, covered with chicken wire, figure 2. A door was installed at one end, located at the animal's rear while running. To prevent the animal's feet from sliding off the side of the belt, triangular strips of wood, 4" in height and 1" wide at the base, were placed along the sides of the cage in close proximity to the belt surface.

PERFORMANCE

The treadmill has been used with 5-25 kg dogs for approximately 350 hours with no mechanical difficulties. With patience, almost any dog can be

taught to run contentedly. The most effective training method is to run the animal for short periods on consecutive days, starting at minimum and slowly increasing to maximum speed. After the training period, the exercise tolerance in any given animal is usually reproducible on different days within 15 minutes. Normal dogs, running at 7 mph on this treadmill, usually have an exercise tolerance, defined as time for collapse, of about 1 $\frac{1}{2}$ hours, although this varied widely from animal to animal. Below 5 mph, most normal dogs can run almost indefinitely. If it is desirable to increase work load, the wooden base can be given varying degrees of incline, since the treadmill is a unit structure.

THE COST

Components and labor were as follows:

Belt.....	\$ 47.00
Motor and Master Speedranger (Master Electric Co., Dayton, Ohio).....	\$305.00
Chain and sprocket.....	\$ 26.00
Ball bearings.....	\$ 13.00
Pulleys, strap iron and miscellaneous.	\$ 40.00
Labor.....	\$200.00
Total.....	\$631.00

SUMMARY

Details have been given for the construction of a cheap, simple, small treadmill, designed for exercising dogs or other small animals. This device has a continuously variable speed range of .8 to 7 mph. Total cost was \$631.00.