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A SYSTEM OF RAT RESTRAINT USING A CONE-SHAPED, PLEXIGLASS AND STAINLESS STEEL ROD CAGE

US ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE Natick, Massachusetts

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TECHNICAL REPORT

No. T6/85

A SYSTEM OF RAT RESTRAINT USING A CONE-SHAPED, PLEXIGLASS AND
STAINLESS STEEL ROD CAGE

by

GLENN J. THOMAS, CANDACE B. MATTHEW, WILLIAM T. MATTHEW, and ROGER W. HUBBARD, Ph.D

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ABSTRACT

A system of rat restraint was needed to allow maximum accessibility to the animal. This system, designed inhouse, is constructed of 3/8" plexiglass and stainless steel rods. Several special design features, including the adjustment of size to accomodate a wide weight range of animals, are superior to commercial varieties. This system has been used extensively in 2 published studies and other uncompleted studies and has adapted well to many applications.

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INTRODUCTION

A system of rat restraint was needed to support ongoing research that would allow maximum accessibility to the animal under various experimental conditions and that would still allow the animal a degree of comfort over long periods of restraint. Commercially prepared small animal restraint cages fell short of meeting all the necessary criteria and so an in-house restraint system was designed.

SYSTEM DESCRIPTION

This restraint system is based on an adjustable length, cone-shaped enclosure of plexiglass and stainless steel rods. (See Figure 1.) The framework of this system is 3/8" plexiglass using chloroform or a cyanoacrylic adhesive (superglue) as a binding agent. A dome-shaped opening in one of the vertical supports is utilized for insertion and removal of the rat. (See Figure 2.) A small, inverted "U" shaped piece of 1/8" plexiglass is inserted between the animal and the rear vertical support to prevent the animal from backing out. (See Figure 3.) The length of the cage is also adjustable by the use of 2 adjustment bolts in a slot on the base support. (See Figure 4.) These bolts allow the overall length of the cage to be varied from 6 1/2" minimum to 10 1/2" maximum for the large unit and 4 1/2" to 8 1/2" for the smaller unit. This feature allows the two sizes of cages to accommodate a wide weight range of small animals. Experience has shown that the small unit is suitable for rats from 100 - 350 gm while the large unit will accommodate rats from 300 - 650 gm.

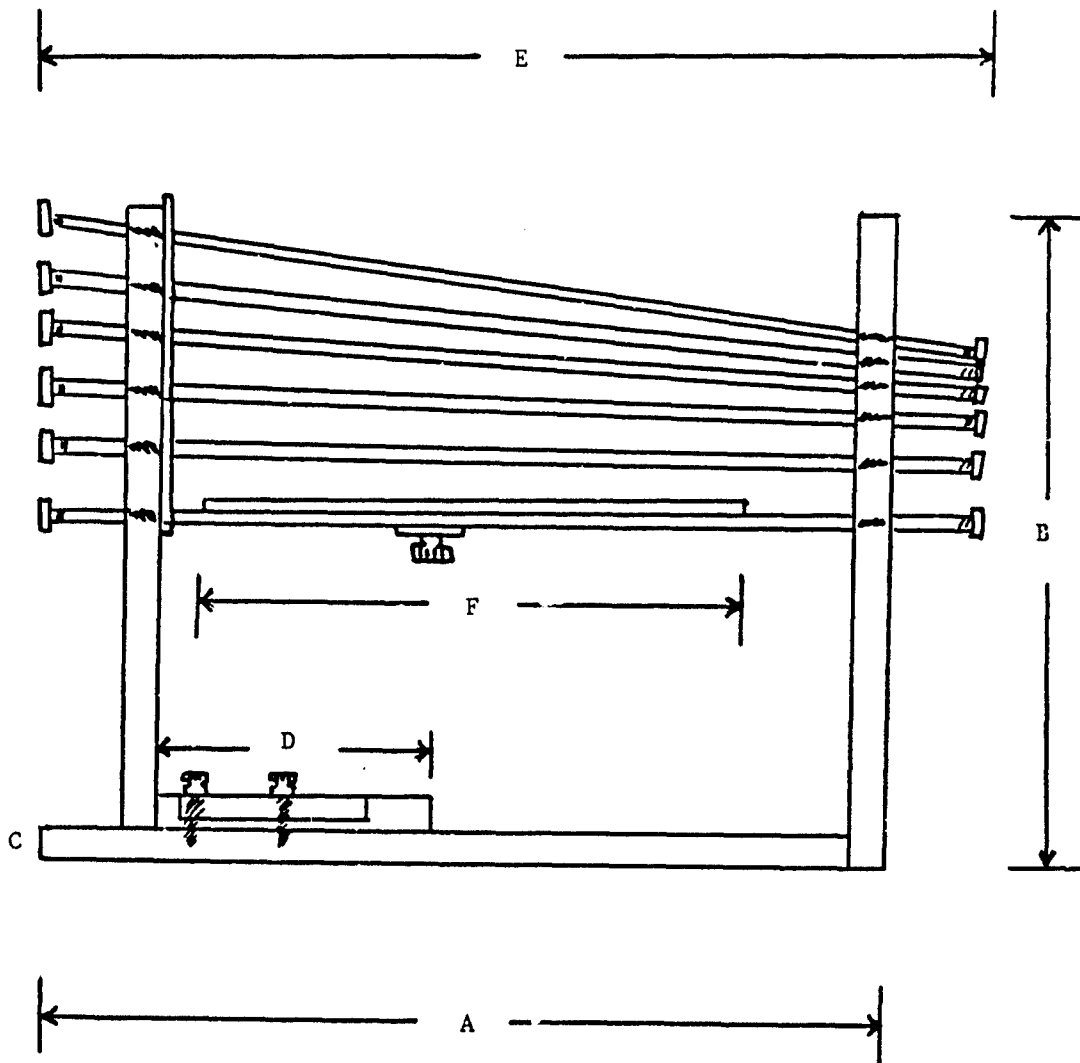


FIG. 1 SIDE VIEW OF RAT RESTRAINT SYSTEM

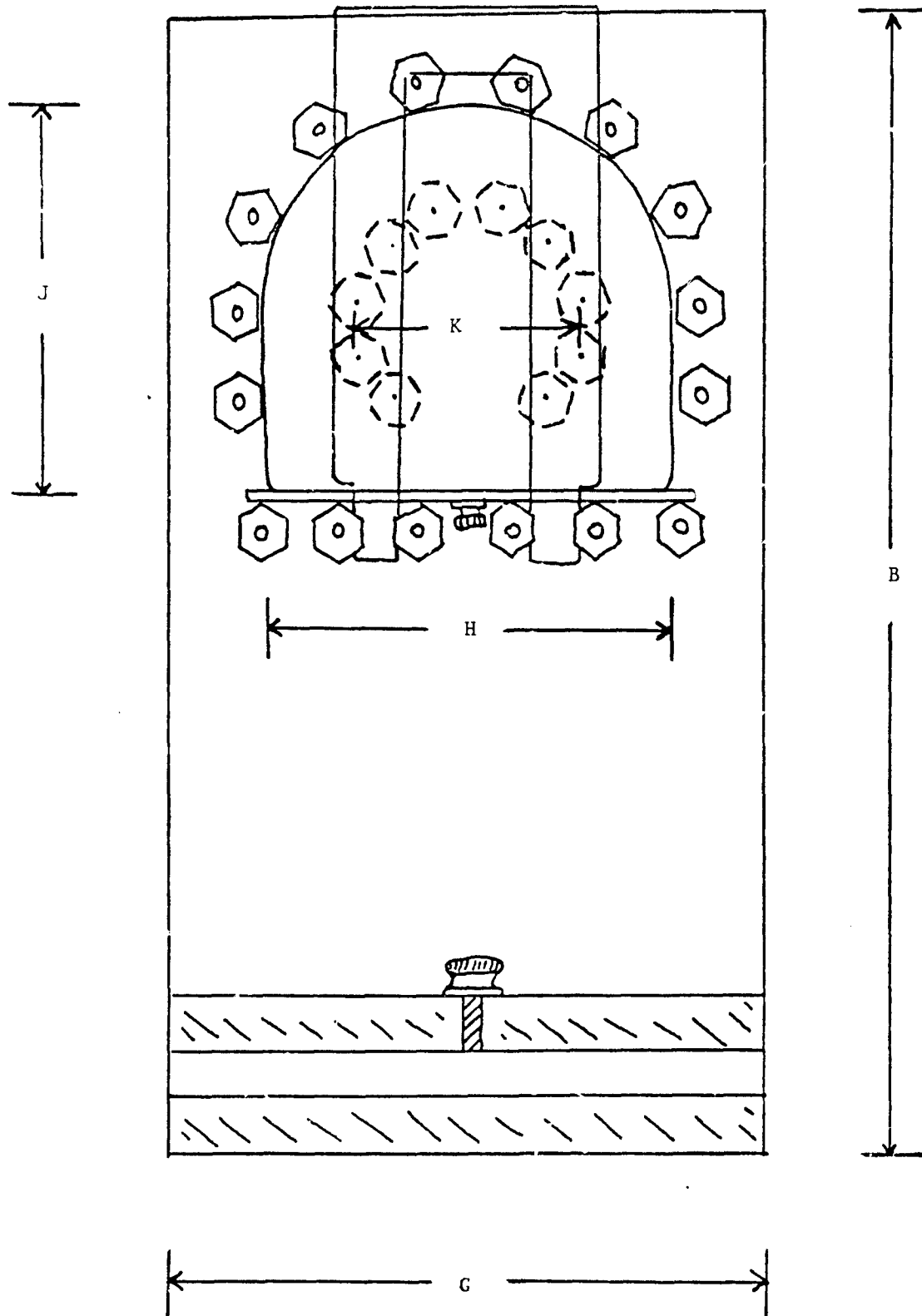


FIG. 2 END VIEW OF RAT RESTRAINT SYSTEM

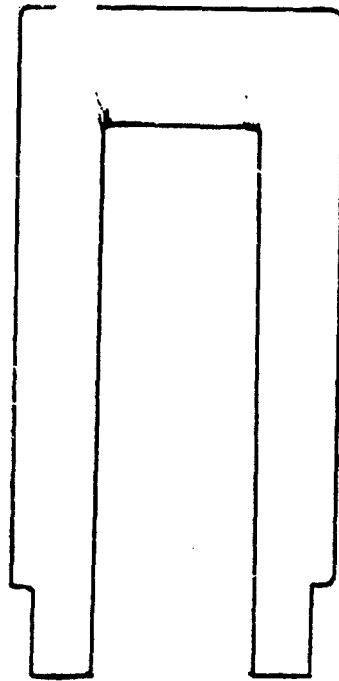


FIG. 3 "U" SHAPED PIECE INSERTED
BEHIND ANIMAL

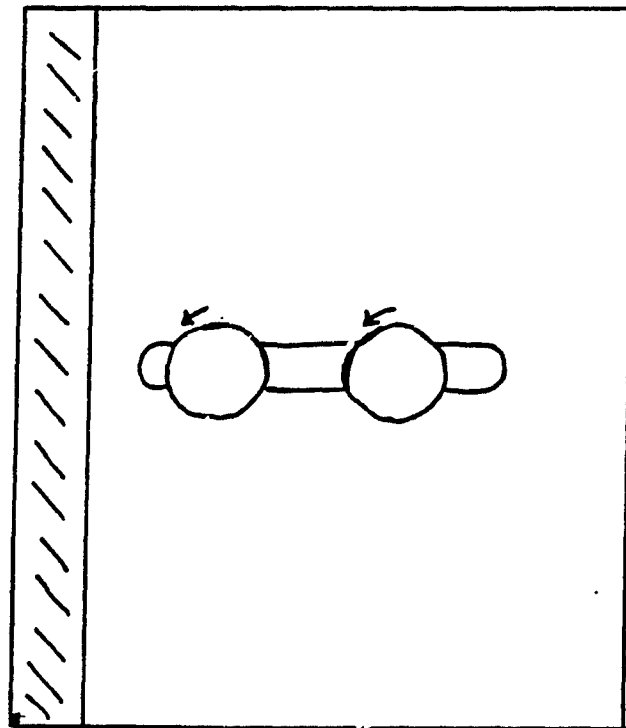


FIG. 4 TOP VIEW OF ADJUSTMENT BOLTS

The 6 rods that comprise the floor and 10 rods that comprise the walls of the restraint chamber are 1/8" diameter stainless steel. These rods are of 2 different lengths to accommodate the size variance of the small and large units. (See Figure 5 for dimensions of both units.) The ends of the rods are threaded and a hexagonal nut placed at each end holds the rods in place.

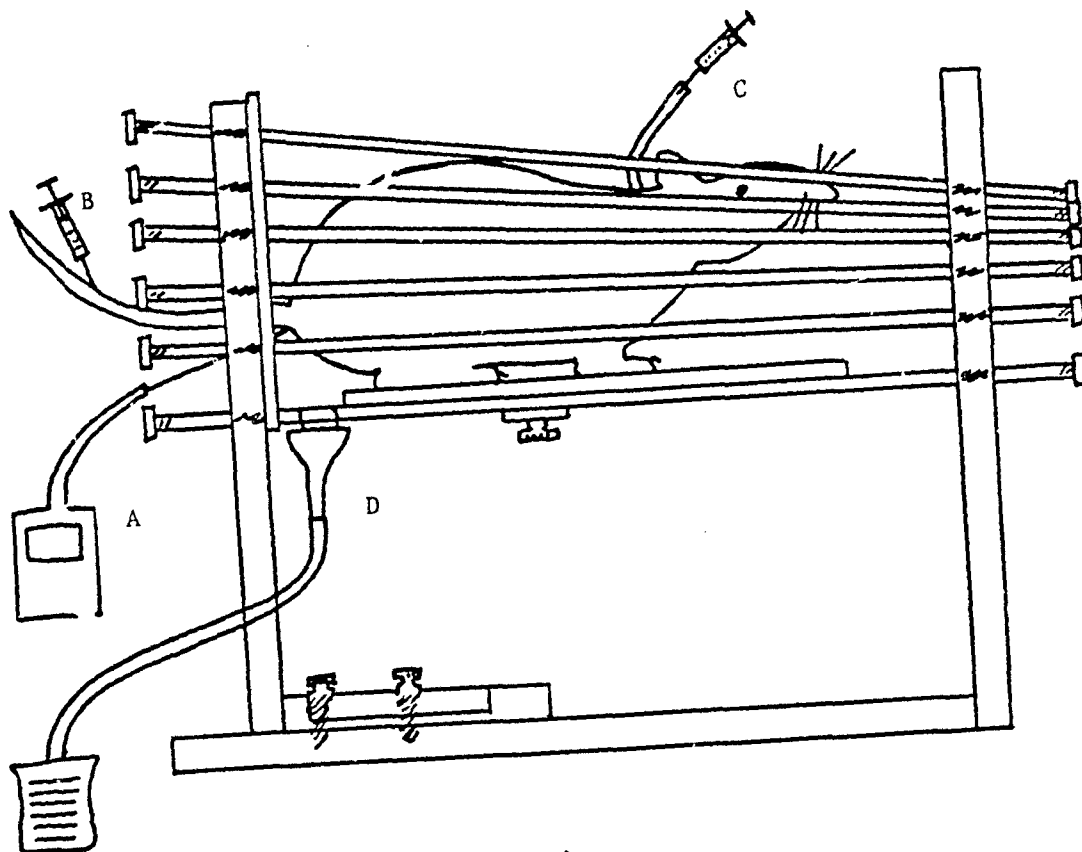
On both models, a plexiglass platform, 6" x 3" x 1/8" on the larger model and 5" x 2 1/4" x 1/8" on the smaller, covers the floor of the unit. (See Figure 1.) This allows the animal to rest its weight comfortably without its legs dangling unsupported between the rods. This platform can be shifted forward in the cage to allow for the addition of a urine output collection device consisting of a funnel attached between the rods, some tubing and a graduated cylinder or pipet. This platform is also removable for better air circulation.

UTILIZATION

This system of restraint has been used frequently over the past several years. Our restraining cages were used extensively in 2 published studies(1,2). The cages have been used to restrain rats for the following purposes in other studies: 1) insertion of rectal probes, 2) injection into, sampling from or fluid replacement through the tail vein, 3) sampling from or injection into cannulae implanted in blood vessels, 4) sampling from lymphatic and salivary ducts, 5) collection of urine, 6) prevention of behavioral thermoregulation during experimental heat stress and 7) observation. (See Figure 6.)

FIG. 5 DIMENSIONS For Fig. 1 & Fig. 2

| DIMENSION | LARGE | SMALL |
|-----------|---------|-------|
| A | 9 3/8" | 7" |
| B | 7 1/4" | 7" |
| C | 3/8" | 3/8" |
| D | 3" | 3" |
| E | 10 1/2" | 9" |
| F | 6" | 5" |
| G | 4" | 3" |
| H | 2 3/4" | 2" |
| J | 2 1/2" | 2" |
| K | 1 1/2" | 1" |



- A. T_c (RECTAL PROBE)
- B. TAIL VEIN INJECTION & SAMPLING
- C. CANNULAE INJECTION & SAMPLING
- D. URINE COLLECTION

FIG. 6 USES OF THE RAT RESTRAINT SYSTEM

ADVANTAGES OVER COMMERCIALY PREPARED SYSTEMS

A. Metal and stainless steel rod restraining cage manufactured by C.H. Stoelting Company, 424 N. Human Avenue, Chicago, Il 60624.

1. Our cone-shaped cage is open on one end for insertion of the animal rather than by removal of 2 rods located on top of the commercial cage; this allows for easy maneuverability of unanesthetized animals into and out of the cage. Most of our rats will readily enter the cage of their own volition.

2. The length of the cage can be adjusted while the cage sits flat on a surface causing less agitation to the restrained animal and minimizing changes in core temperature (tc), heart rate, urine output and blood chemistrys. The commercial version must be tipped on end while adjustment screws (located under the unit) are turned.

3. Our cage allows total access to the tail for tail vein injections since the tail remains outside the cage and can be easily warmed to dilate the tail veins.

4. Greater access to the anal region for easy insertion of temperature probes and removal of fecal matter.

B. "Broome" Restrainers and other Acrylic Systems

1. During heat-stress experiments the ambient temperature inside our cage does not rise. In constrast, other commercial models produce heat stress due to the inability of the animal to dissipate heat through the acrylic.

2. During prolonged periods in the cage the open-walled design allows for a better air quality received by the animal and for evaporation of moisture due to normal physiological processes.

3. Our cage allows for accessibility to measure urine output by the addition of a funnel, tubing and a pipet attached between steel rods on floor of chamber.(See Figure 6.)

4. Our variable length cone-shape does not allow the animal to attempt to turn around and thereby suffocate or injury itself.

5. The open space between rods improves accessibility to cannulae surgically implanted in the body for blood studies, drug injections and fluid replacements.

6. We have a direct view of the animal's eyes for post drug injection examination - e.g. pupil dilation.

7. False "spreading" of urine or saliva that would normally rest on the bottom of the commercially prepared unit is eliminated since the platform in our cage can be moved so that it is located between these two areas of fluid loss.

CONCLUSION

This cone-shaped, plexiglass and stainless steel rod system of restraint has become an integral part of our small animal research effort and is easily adapted to a broad range of specialized study requirements.

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