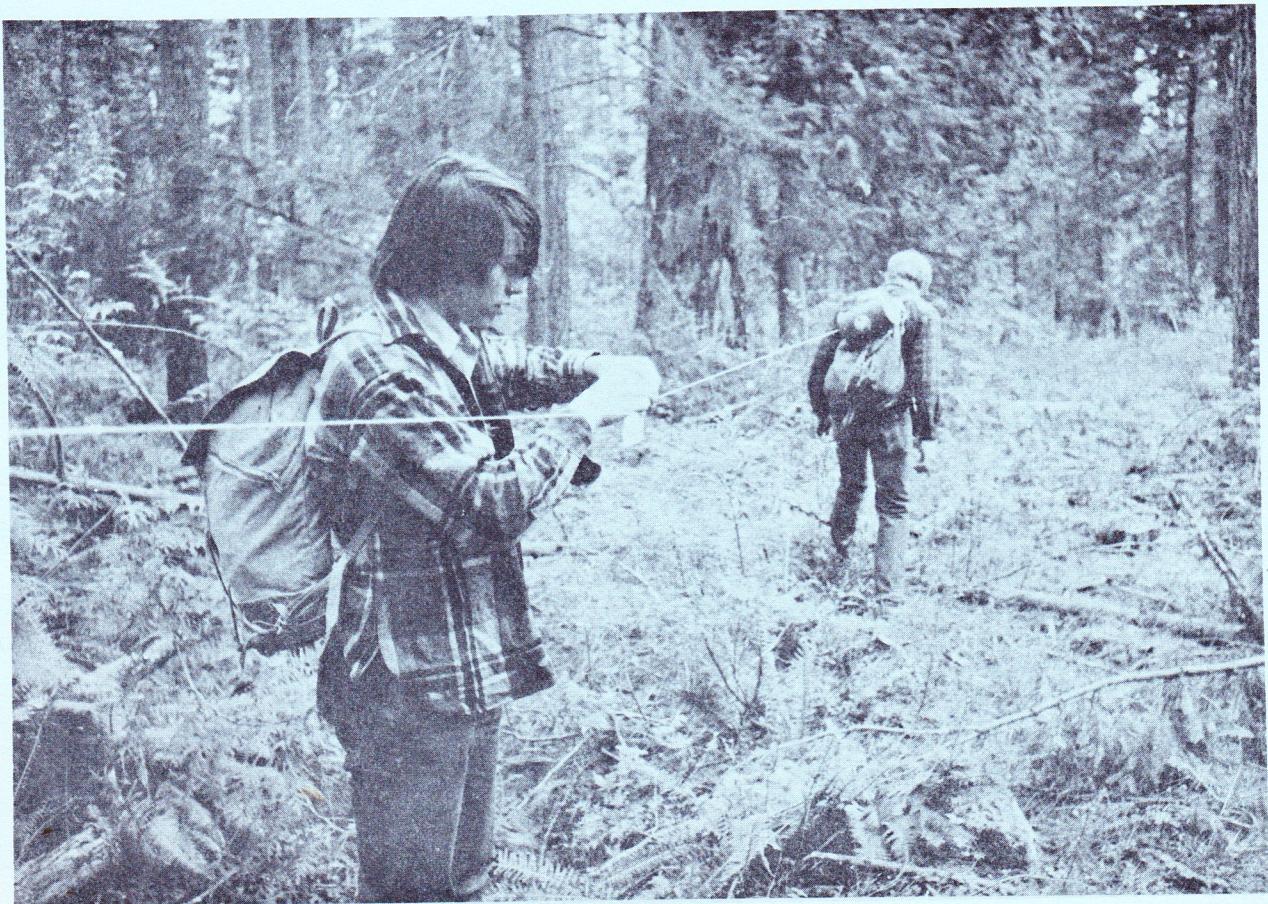


WESTERN REGION

EXPLORER SEARCH & RESCUE

**THE USE OF STRING LINES
FOR SEARCH & RESCUE**

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THE USE OF STRING LINES FOR SUBJECT CONFINEMENT,
SEARCH AREA SEGMENTATION, & GRID SWEEP
CONTROL

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Grid (sweep) searching has for many years been a speciality of the Explorer Search & Rescue (ESAR) units within Oregon and Washington. For much of this time, the Oregon units have been using string lines for grid control. Recently, units in both states have begun using string lines for other purposes as well.

CONFINEMENT

The writer's first search experience was for a lost hunter in Western Washington many years ago. We searched a very large area with no results. Seven years later, the hunter's remains were found many miles to the east. Had he hiked north, west, or south, he would have come to a road. He went in the only direction he could have gone and not walked out!

This experience suggests the need for a rapid and reasonably effective way to confine the subject inside boundaries he is unlikely to cross.

In his section on search tactics, Dennis Kelley¹ described a 5 mode strategy. They are (1) Preliminary mode, (2) Confinement, (3) Detection, (4) Tracking, & (5) Evacuation. The second mode, confinement, is based upon the principle of trapping the subject inside a known area and then searching the area. Suggested methods of confinement include roadblocks, trail blocks, lookouts, camp-ins, & track traps. However, in the more wooded areas, where visibility is less, there is a need to mark off the boundaries in a fairly definite fashion.

In a recent study based upon 92 search operations, Bill Syrotuck² found that the survival rate of persons lost during bad weather was low (37.5%). He emphasizes the need to react quickly and goes on to define zones of highest probability based upon the point where the subject was last seen. These statistics may provide useful information to help set the outside boundaries of a search as well as to identify the most probable zones within

the area.

A practical need, as a consequence of using zones of probability in search planning, is to mark these zones for easy use by searchers.

One solution in wooded or brushy areas is the use of string lines for confinement and area segmentation. When combined with tags (placed every 100 to 300 ft.) which point the direction to search base, string provides a definite line that is easily noticed and easy to follow. Other advantages include: (1) they take little time to put in (about 2/3 of walking speed; the string takes no extra time, the tags require some.) (2) String is easy to obtain, (3) It is not too expensive (\$1.90 per 6,000 ft cone.) (4) The string is rather strong. If it jams inside the string can, it will usually bring the searcher to a stop rather than break. 4-ply cotton is used.

Disadvantages include: (1) A subject in a state of shock or panic may go through a string line without recognizing its use to him. (2) Bulk and weight (a 6,000 ft. cone weighs 2 lbs.) (3) The appropriate materials have to be stocked ahead of time - they cannot be thrown together at the last minute. (4) The string may become an eyesore until it rots away (2 to 8 months usually.) In suburban areas, parks, or other areas of high public use, it may be desirable to take in the lines after the search.

Sample of tags used to mark string lines
(Printing on both sides)

EXPLORER SEARCH & RESCUE

LINE # _____ TEAM _____

TAG # _____

SEARCH BASE

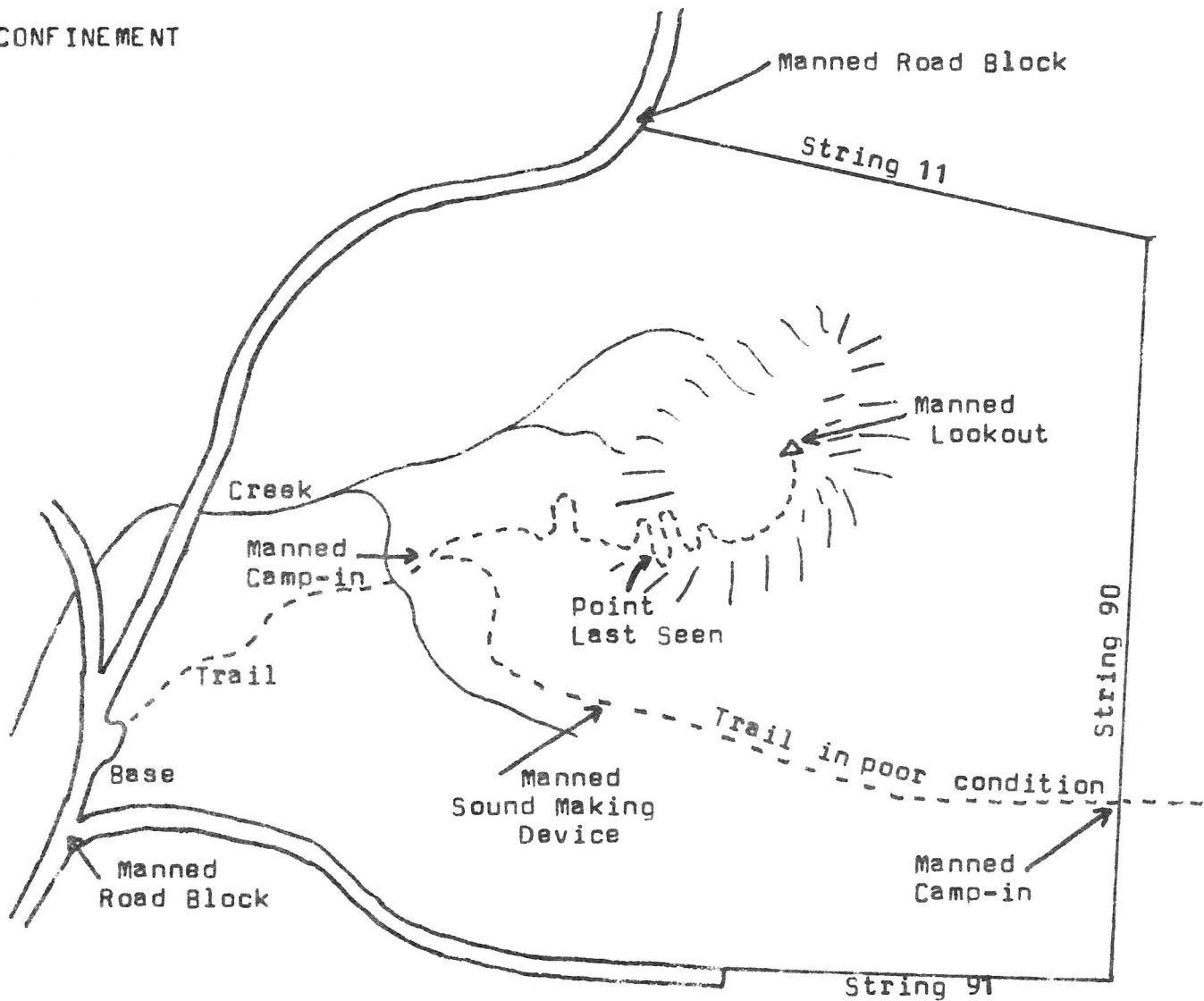
Probably the critical question on using string for confinement is whether or not the subject will recognize and use the line to his benefit. One Oregon ESAR unit did have a lost person follow out a line that they had set for grid control purposes. However, use of string lines for confinement in wooded areas is still new to us. An evaluation of its effectiveness will have to wait upon additional field experience.

SEARCH AREA SEGMENTATION

Once the subject has been confined within a known area, the process may then become one of dividing up the area into smaller zones. Again tagged string lines may be useful. This segmentation of the area makes possible several things. (1) It will confine the subject inside an even smaller area thereby reducing the time until he wanders into a string line (assuming he is up and wandering.) (2) Teams can then be assigned to distinct manageable areas to search. The most probable areas would be searched first. Because the lines, with reference numbers tagged on each line, make definite boundaries, confusion between base-camp and field teams regarding assignments and locations is minimized. Consequently it is administratively possible to utilize a large number of searchers. ESAR has conducted many operations with up to 200 members. With the segmentation described above, more could be used without undue confusion.

AN EXAMPLE OF HOW A SEARCH MIGHT PROGRESS IN A FORESTED AREA

CONFINEMENT



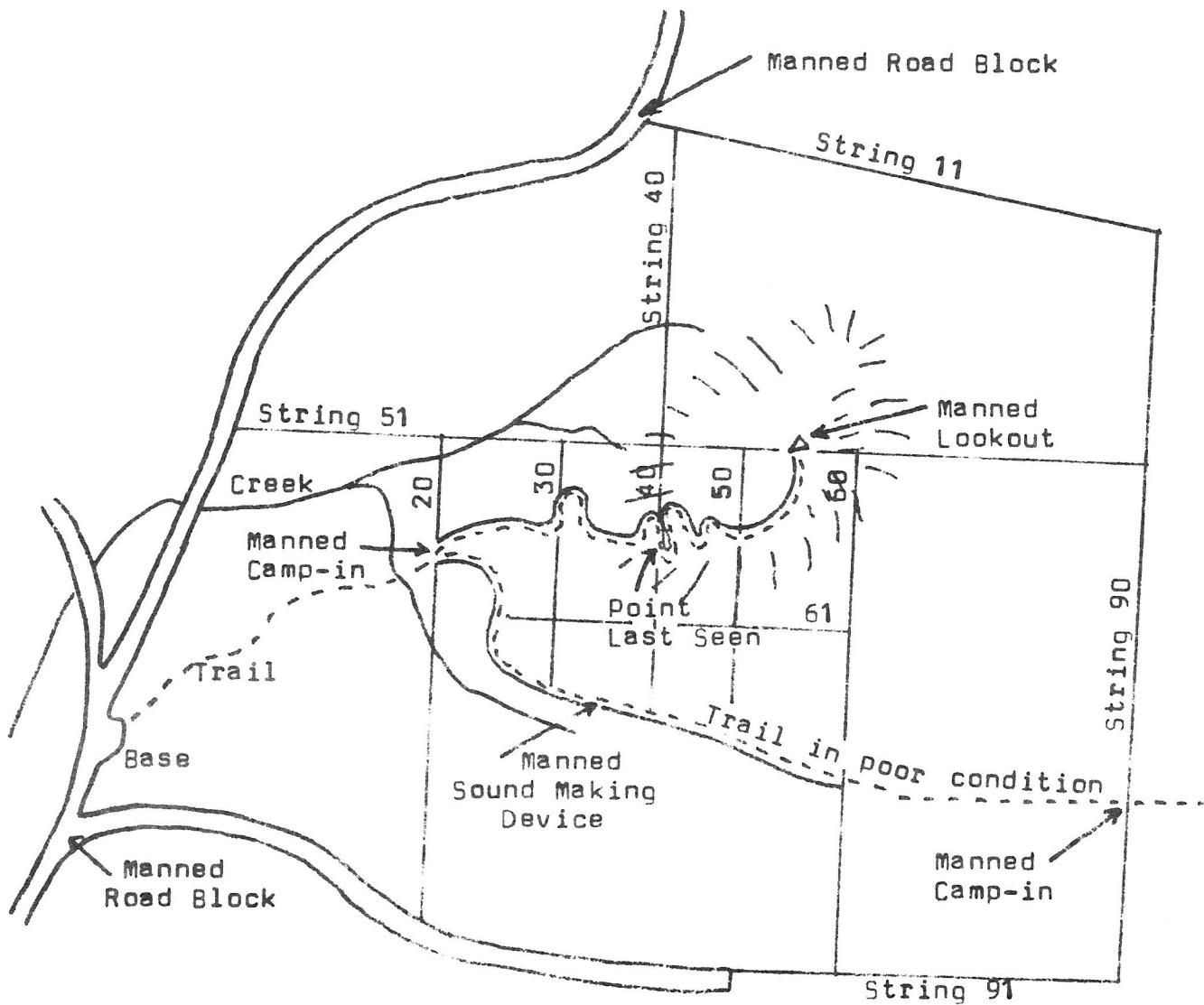
In this hypothetical example, the lost person was hiking up toward the lookout. A reasonable theory might be that he unintentionally walked off a switchback.

The confinement is accomplished by roads on the west and by string lines on the east. Manned camp-in's and road blocks would be set up at appropriate places.

EARLY DETECTION

Search dogs could be brought in for tracking. Teams could hike the trails, check shelters, walk game trails & drainages, etc. The emphasis would be upon the area immediately around and down hill from the point last seen. A manned sound making device might be used to attract the subject to a trail. (ESAR refers to these kinds of efforts as a Type I search. Dennis Kelley labeled it reconnaissance.)

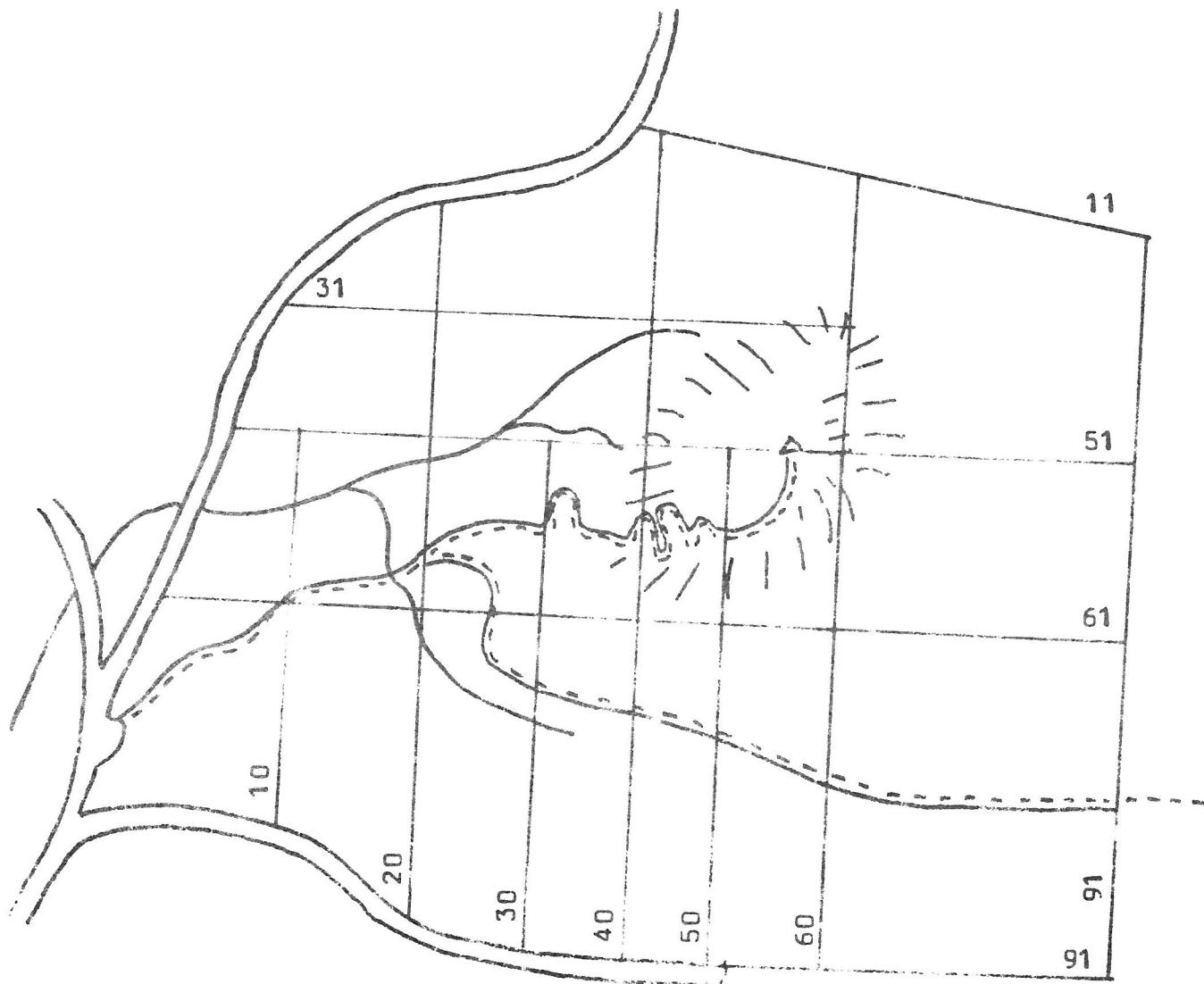
DETECTION - EARLY SEGMENTATION



As the early trail checks, etc. prove negative, teams could be assigned to run string lines in the vicinity of the highest probability search areas. Grid teams can then start to sweep those zones. Note that while string is used to mark zones, trails and natural terraine features can be used too. Meanwhile several other lines (#40, 60, & 51 in this example) serve to divide up the whole search area into smaller parts. Should the subject be wandering, it should take less time for him to find a string line.

For reference, each string has been tagged with a number every several hundred feet. In this example, odd numbers are used for E-W lines and even numbers for N-S lines.

DETECTION - ADVANCED SEGMENTATION



As time passes, the failure of the subject to find and follow out a string line may be due to any of three reasons:

1. He was not inside the original boundaries.
2. He has passed through the boundary.
3. He is down or at least not able to travel far.

As the highest probability zones are searched, additional lines can be placed to define the next search areas.

As the most likely areas are searched and prove negative, a real problem comes up. The size of the confined area vastly exceeds the capabilities of the available manpower to adequately search. There is no one resolution to this problem. Partial solutions include:

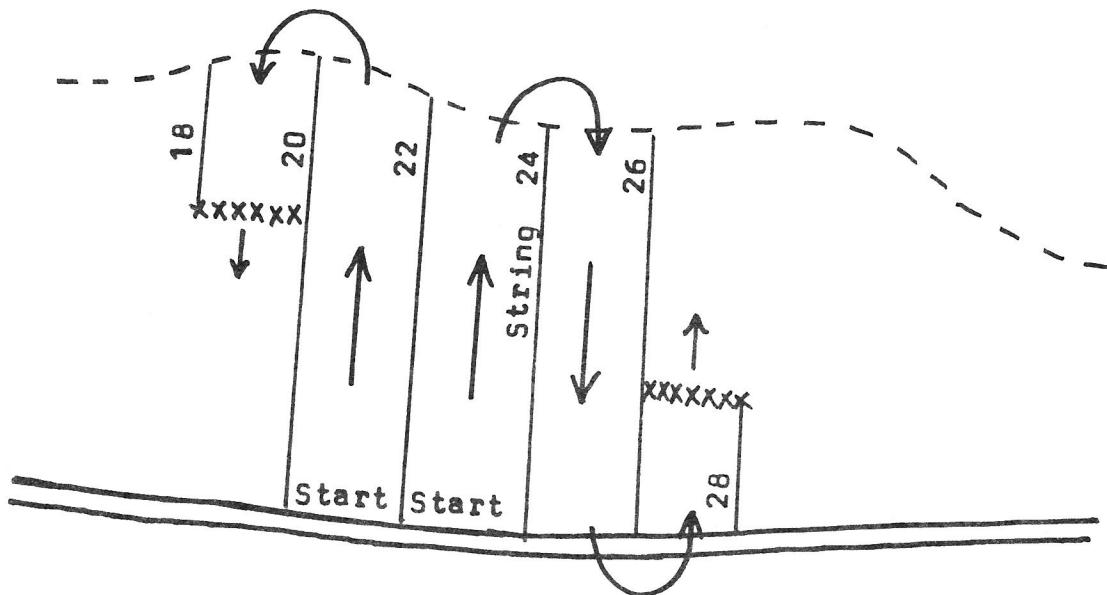
1. Finding and testing better search methods.
2. Refine the ability to identify the most likely search areas.
3. Recruit, train, and use greater manpower resources.
4. Respond to the search early enough so that the outside boundaries are as small as possible.

GRID SWEEP CONTROL

The Oregon ESAR units originated the use of string to mark searched from unsearched areas while gridding. The process is simple, requires less distraction of the end man than laying ribbons, & provides a boundary that is easily followed by subsequent teams.

About the only disadvantage is that if string lines are used for segmentation as described earlier, the area might become too cluttered with lines if string was also used for sweep control. In such cases, ribbons or compass might substitute for control purposes. As long as the search zones are of manageable size, this shouldn't be too difficult.

String used for Grid Sweep Control
(Two teams shown)



Tags identifying the line number are placed on the string at the ends and at intervals of several hundred feet.

ADDITIONAL ADVANTAGES OF TAGGED STRING LINES

1. Directing teams to locations - The absence of firm landmarks in heavily wooded areas makes it more difficult for one team to give locations to others.
 - (a.) Each tag becomes a location. Example: "We are at the 1400 ft. tag on line #60."
 - (b.) The lines themselves become access routes. Example: "Follow string #20 north until you intersect line #51. Go east on #51 to the 1800 ft. mark. Team #3 is 400 ft. south of that tag."
2. Directing teams to the subject - When the subject is found and other teams are routed to the location to assist with the evacuation, a single string can be set in by two members of the finding team to mark the route. Directions then become quite simple: "Go up the trail to the string (specify number) and follow the string to the subject."

THREE IDEAS COMBINED

Three ideas have been put together in a practical arrangement. Dennis Kelley's proposal of confining a lost person within definite boundaries early in the search is supported by the use of tagged string lines as a hopefully practical method of accomplishing this confinement in wooded or brushy areas. Bill Syrotuck's work on identifying search zones of greatest probability is also aided by the use of string lines to mark these zones in an effective manner for use by searchers.

The actual putting-together of these ideas on real operations is perhaps the next step. Beyond that will come an evaluation of the results obtained.

REFERENCES

- ¹ Kelley, Dennis, Mountain Search For The Lost Victim, 1973. \$3.95. P.O. Box 153, Montrose, California, 91020.
- ² Syrotuck, William G., A Statistical Analysis Of Lost Persons In Wilderness Areas, Number Two, 1973, \$2.50, Arner Publications, Rome, New York.

STRING DISPENSER

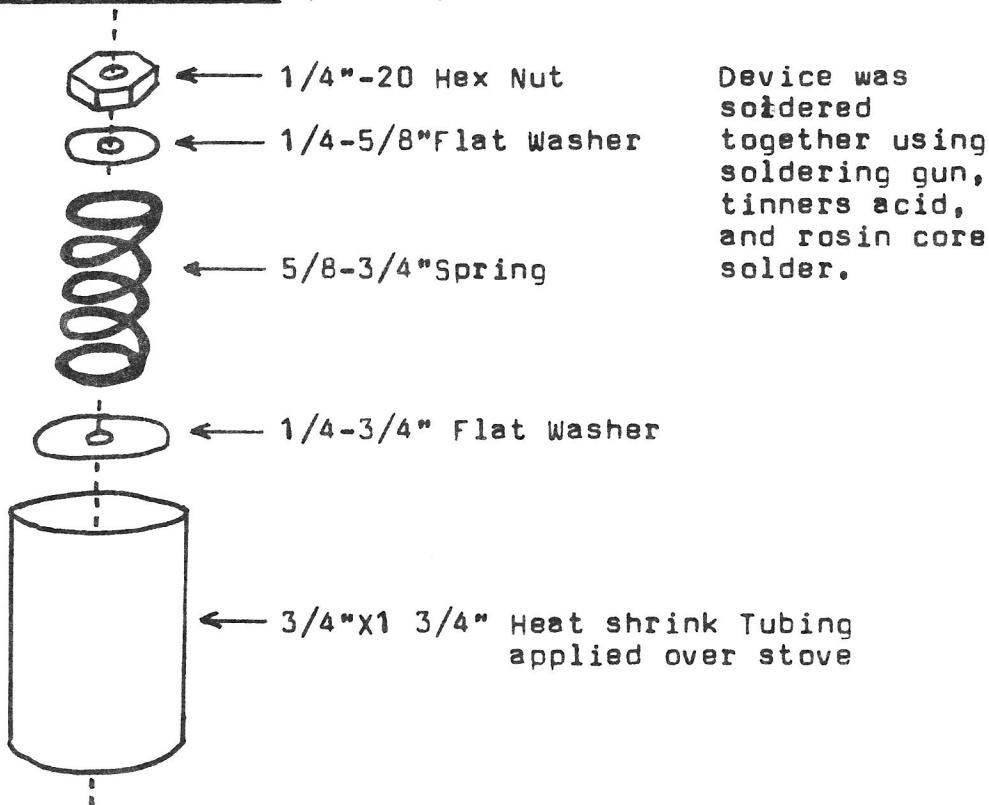
Several kinds of string dispensers have been developed by various units. The following is a description of one.

SPECIFICATIONS: Height 9 $\frac{1}{2}$ "
Width 6"
Weight 2 $\frac{1}{2}$ lbs. empty

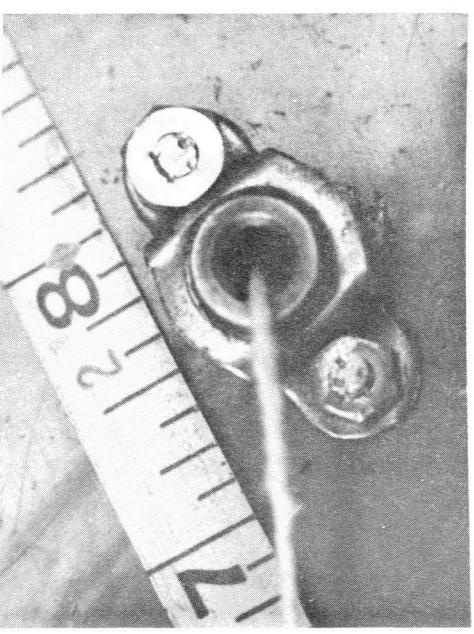
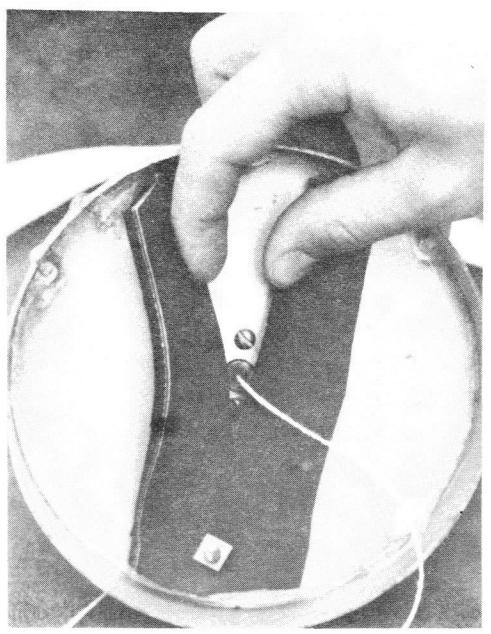
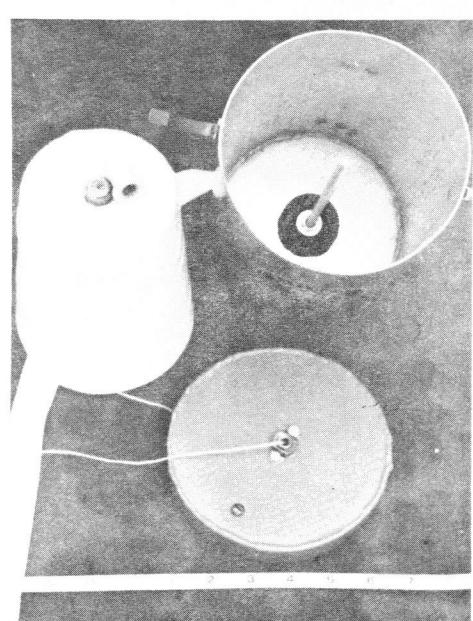
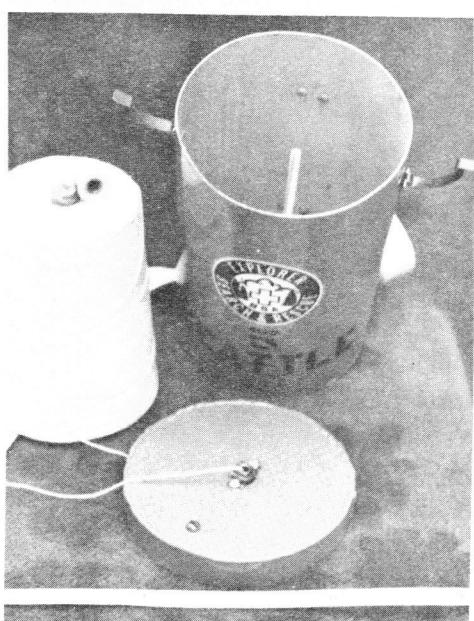
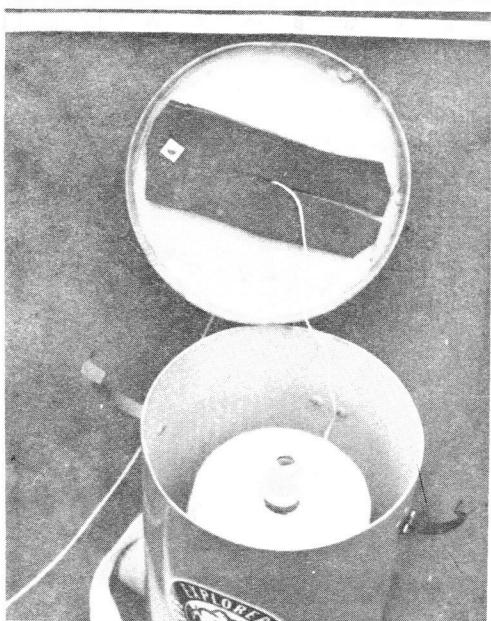
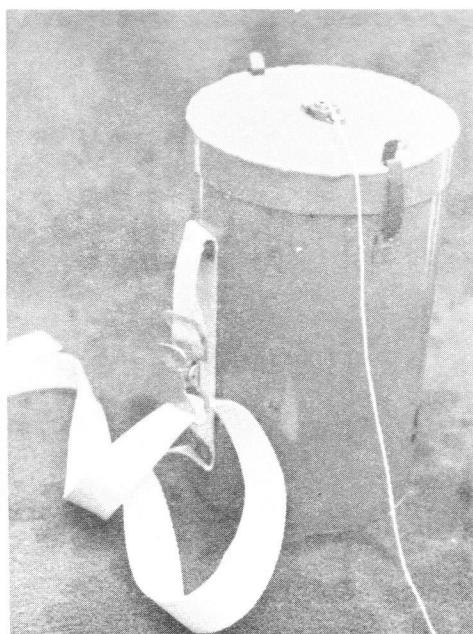
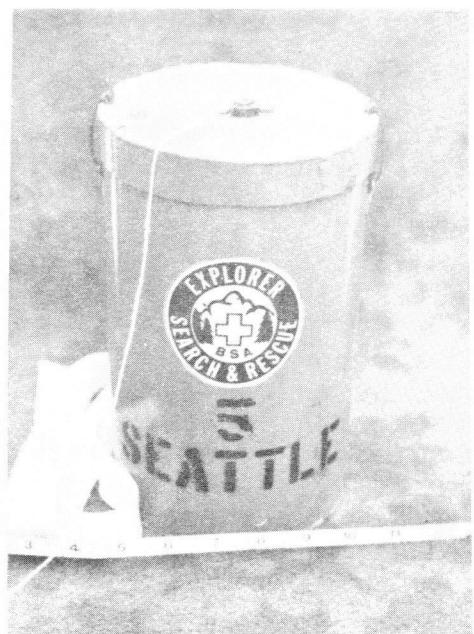
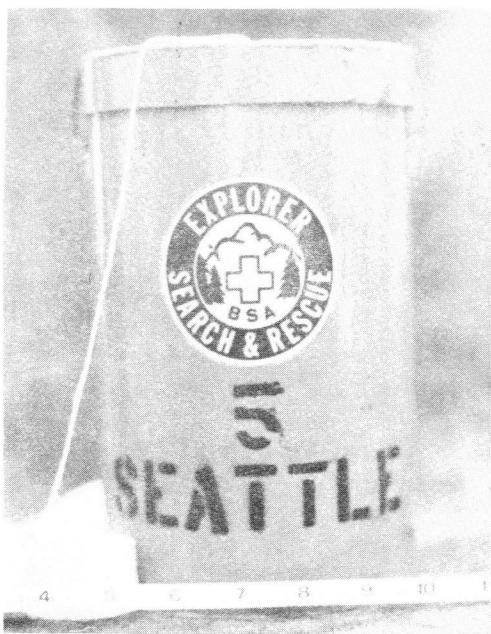
FEATURES: Works in any position.
Unaffected by sudden changes of movement.
Resists snagging on brush.
Easy to operate, minimum parts, no moving parts.
Durable case, cone protected from weather & physical abuse.
Easy to operate carrying strap.
Easy to repair.

PARTS DIAGRAM:

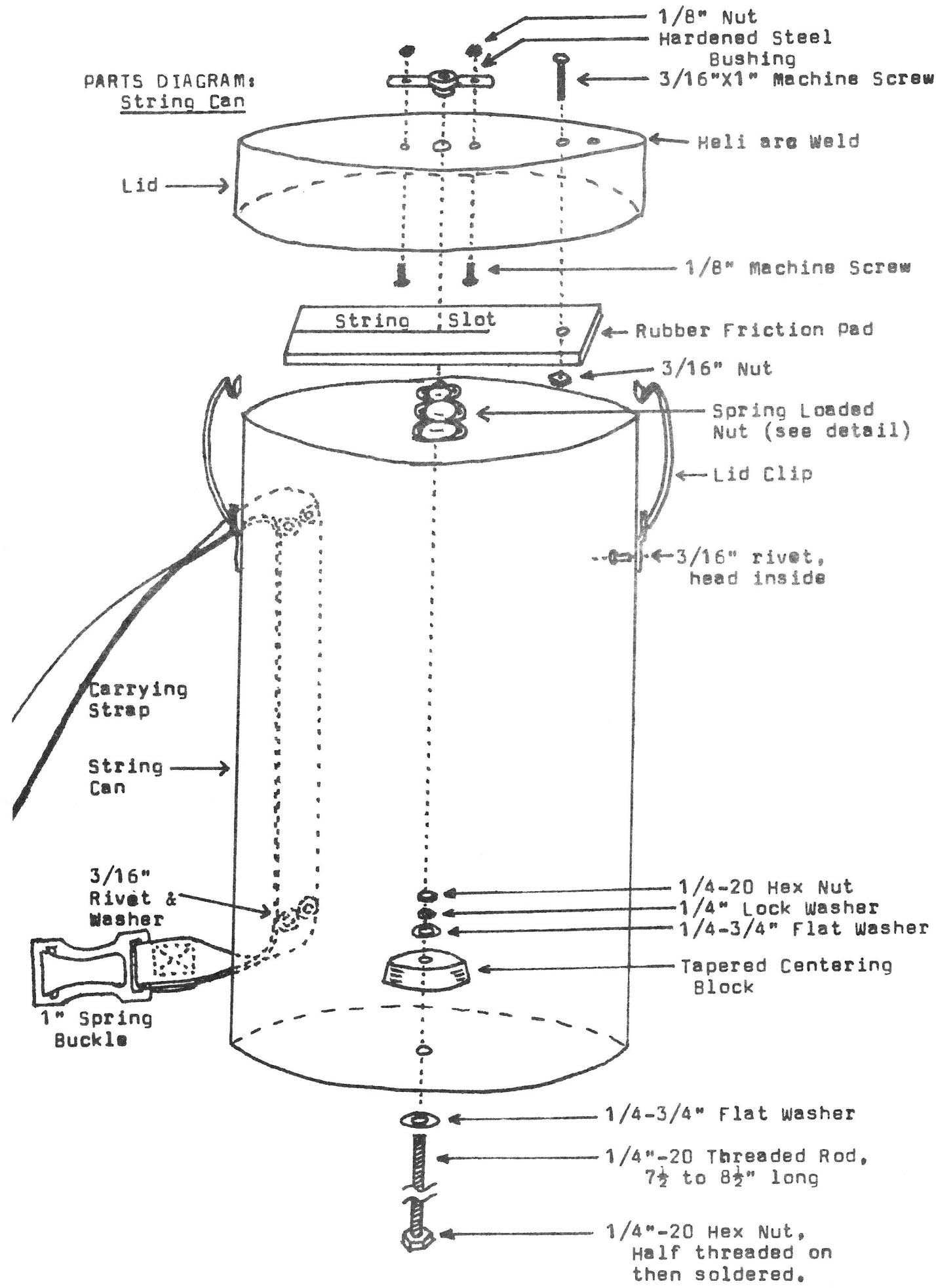
Spring Loaded Nut (Detail)



The easy to grasp spring loaded nut was developed to hold the cone in position. Just a few turns against the spring is needed. The spring applies constant pressure to the cone and does not take a strong arm to tighten or loosen. The heat shrink tubing is to prevent the string from snagging on the spring. The spring loaded nut means only one part to hang on to, other than the lid, while changing cones.



PARTS DIAGRAM:
String Can



PARTS LIST

- 1 1/4"-20 Threaded rod, 7 $\frac{1}{2}$ to 8 $\frac{1}{2}$ " long
 2 1/8" X 1/2" Machine Screws
 1 3/16" X 1" Machine Screw
 6 3/16" X 3/4" Rivets
 3 1/4"-20 Hex Nuts
 2 1/8" Machine nuts (match 1/8" screws)
 1 3/16" Machine nut (match 3/16" screw)
 3 1/4"-3/4" Flat Washers
 1 1/4"-5/8" Flat Washer
 4 3/16"-1/2" Flat Washer
 1 1/4" Lockwasher
 1 5/8" X 3/4" Spring
 1 3/16" Hardened Steel Bushing (Grill guide bushing)
 1 3/4" X 1 3/4" Heat Shrink Tubing
 2 Lid Clips, Delco Auto distributor cap clips.
 Part # 1871838, Spring
 Part # 1847289, Support
 The spring must be reversed and filed to work properly
 then riveted to can.
 1 1" Spring buckle, sewn to carrying strap.
 1 1/16" X 1" Solid nylon webbing, 36 to 48" long, riveted
 to can.
 1 1/4" X 1 1/2" X 5" 4-ply rubber. This friction pad
 causes the string to be straighter and ride higher
 on the brush. Trim pad to fit inside the lid. Keep
 replacement pads on hand.
 1 16 ga. X 5 1/2" Aluminum pipe, 10" long. 1" is cut off and
 a piece added to form the lid ring. Circular plates are
 cut and welded to lid ring and one pipe end to form
 the can.
 1 16 ga. X 6" X 12" Aluminum sheet. For circular plates for
 ends of can.
 1 1 3/4" O.D. Exterior Plywood, For centering block.
 1 2 lb. Cone of 4-ply cotton string (6,000 ft.)

Zinc Chromate should be used to prime aluminum before applying desired high-visibility paint.

If possible, screws should be cut flush with nuts, filed and peened to reduce chance of string snagging and working loose. The rubber friction pad must be long enough to not snag string as it peels off the cone. The threaded center rod should not be longer than necessary.

Good Luck! Suggestions and comments will be appreciated.