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HIGH ALTITUDE LEAFLETING WITH PLASTIC BALLOONS

6 June 1961

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Part I

It is the objective of the following pages to describe a balloon system that can carry and dispense leaflets over distances exceeding 300 nautical miles. Once properly inflated and released, these balloons will ascend to very high altitudes and float there for extended periods of time. The leaflet payload may be dispensed using a simple time delay or other mechanism.

This balloon system is of particular advantage in meteorological situations wherein winds at lower levels may be unfavorable, but high altitude winds favorable in direction and velocity for leafleting a desired target. The strength of these high altitude winds determines how far the balloon will travel during a given time period. The balloons described in these pages will float for at least 8 hours, and ranges can be quickly figured for given wind velocities.

The balloons are made of the plastic called polyethylene. They are called pillow balloons because their shape roughly resembles a large pillow case. When full of gas and carrying a known weight these balloons will have a known volume. This volume-weight relationship establishes how high the balloon will ascend before becoming full. When full they will float level. A slow loss of gas can be expected when floating and a device must be used to compensate for the loss of gas. This device, called a ballaster, expends alcohol when needed and is described more fully in later pages.

There is one very important feature of this type balloon that might not have been made clear enough in previous instructions; this feature is called "Sunset Effect." Briefly, this effect can be summarized by stating that this type of balloon will not continue floating through the sunset period. It will descend unless a very large amount of ballast is dropped to compensate for the large loss of lift that sunset causes. This being so, the time of balloon launching should be chosen at least 8 hours before sunset, if an 8 hour flight is planned.

There are two balloon sizes, two payload weights, and two floating altitudes described in these instructions. A study of weather records for the target area determined the two altitudes, the payloads for the two balloons were then established. One balloon has a volume of 11.33 cubic meters (400 cu. ft.) and carries a payload of about .75 kilogram (2 pounds) of leaflets. This balloon with this load floats at 12,192 meters (40,000 ft.). In these instructions this balloon will be referred to as the large balloon and the floating altitude as the high altitude.

The second balloon has a volume of 7.08 cubic meters (250 cu. ft.). This balloon will carry a payload of about 2.99 kilograms (8 pounds) to 3048 meters (10,000 ft.) altitude. This balloon will be referred to as the small balloon and the altitude as the medium altitude.

A leafleting mission consists of launching the balloons at the proper time to take advantage of favorable winds that will carry the leaflets to the target area. This requires close communication with the meteorologist responsible for making the forecast. It requires that all equipment be available at the launch site, so that it can be made ready for flight on short notice, and necessary trained personnel be available. The mission cannot be scheduled in advance since it depends on favorable winds and these winds may occur only four or five times during the summer. They cannot be expected at all during the winter. Probably 12 hours notice can be given of the expected occurrence of favorable winds. Everything must be made ready within that time period.

The equipment need for a high altitude leaflet balloon is listed on page 16 of these instructions with a sketch that shows how to rig this equipment on the balloon. This sketch shows the payload and ballaster rigged on a tip-balance device. This system will dispense the leaflets when the ballast container is nearly empty. The second sketch on page 17 show a method of rigging the medium altitude balloon using a timer. Either the timer or tip-balance may be used for high altitude depending on the availability of equipment and the accuracy of the elapsed time desired.

The equipment needed for the medium altitude leaflet balloon is listed on page 17. This sketch shows how the equipment should be rigged; it will be noted that a timer is used. A tip-balance could be rigged for this heavier load, but the use of a timer is recommended. An explanation of the rigging procedure follows in Part II.

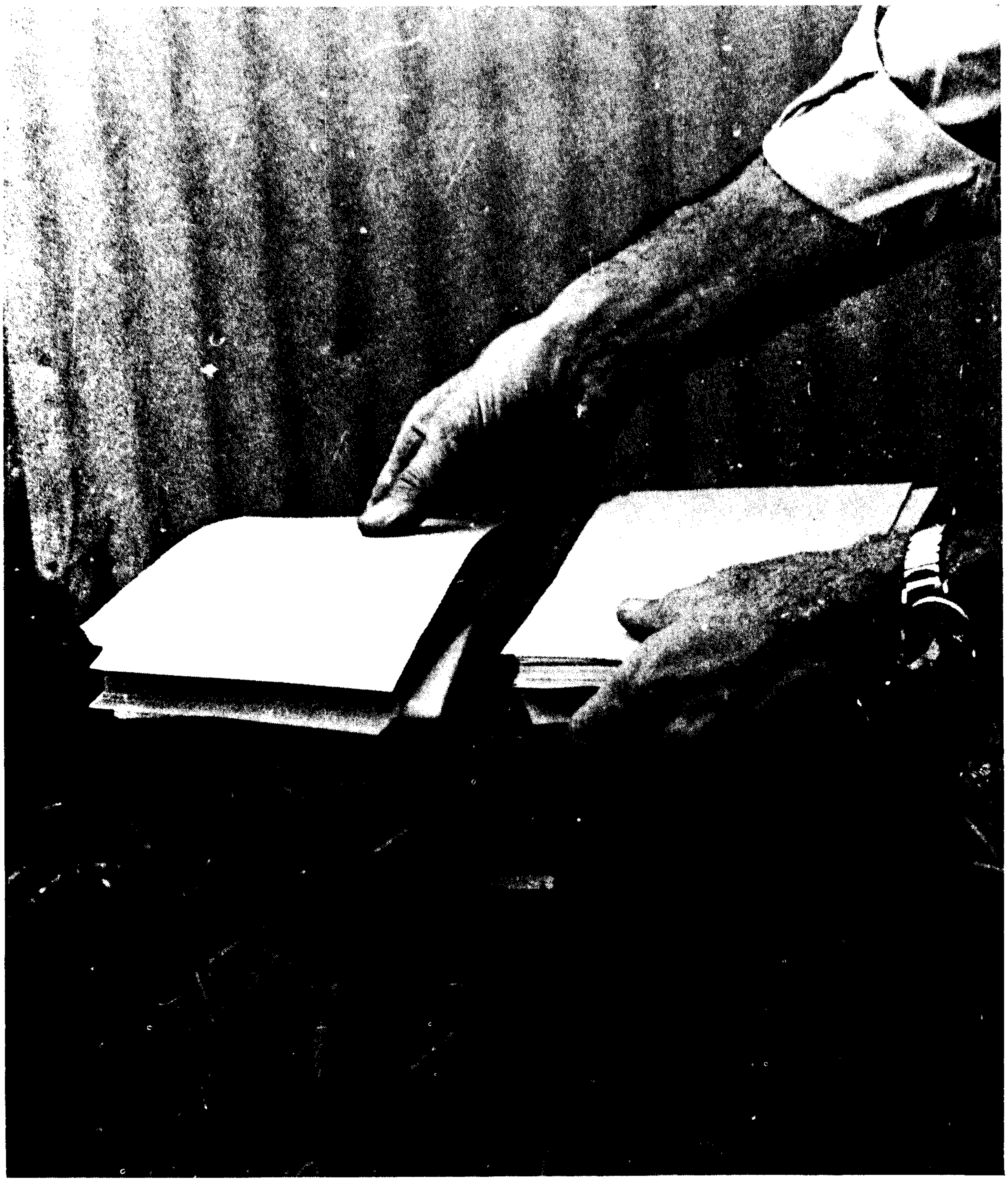
Part II

(Upon Receipt of 12-Hour Notice of Expected Favorable Winds)

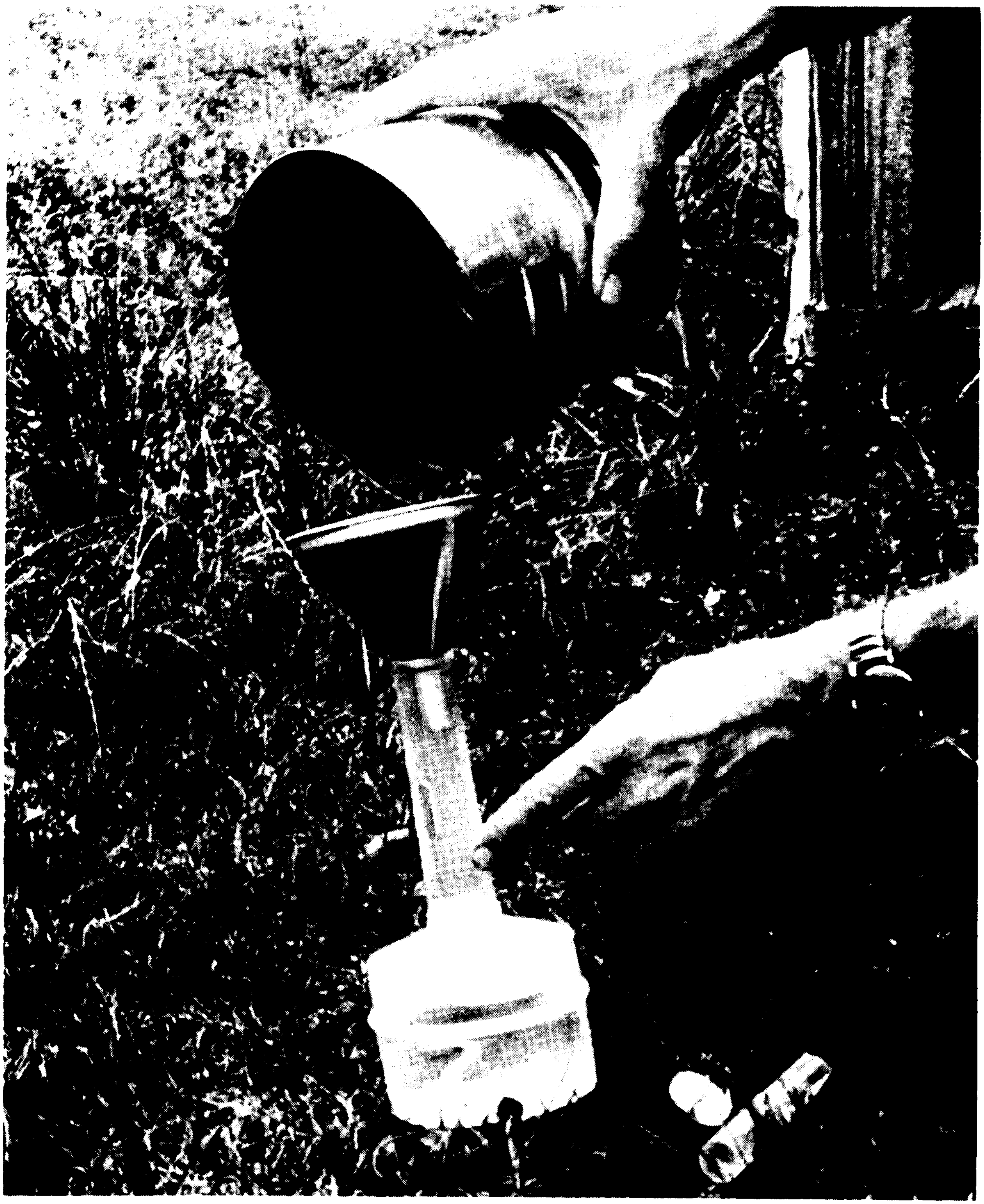
1. To prepare the balloon equipment for a leafleting mission at high altitude (12,192 meters), all balloon equipment that is to fly is put on a scale with the weight preset at 2.991 kilograms. Leaflets are then added until the total weight of equipment balances the preset figure. A photo of a scale with this equipment is shown below. The equipment consists of:

(a) large balloon
(b) full ballaster
(c) payload container assembly
(d) end fitting and cork
(e) balance tipping device or timer
(f) prerigged cord with snap for tying off the balloon base.

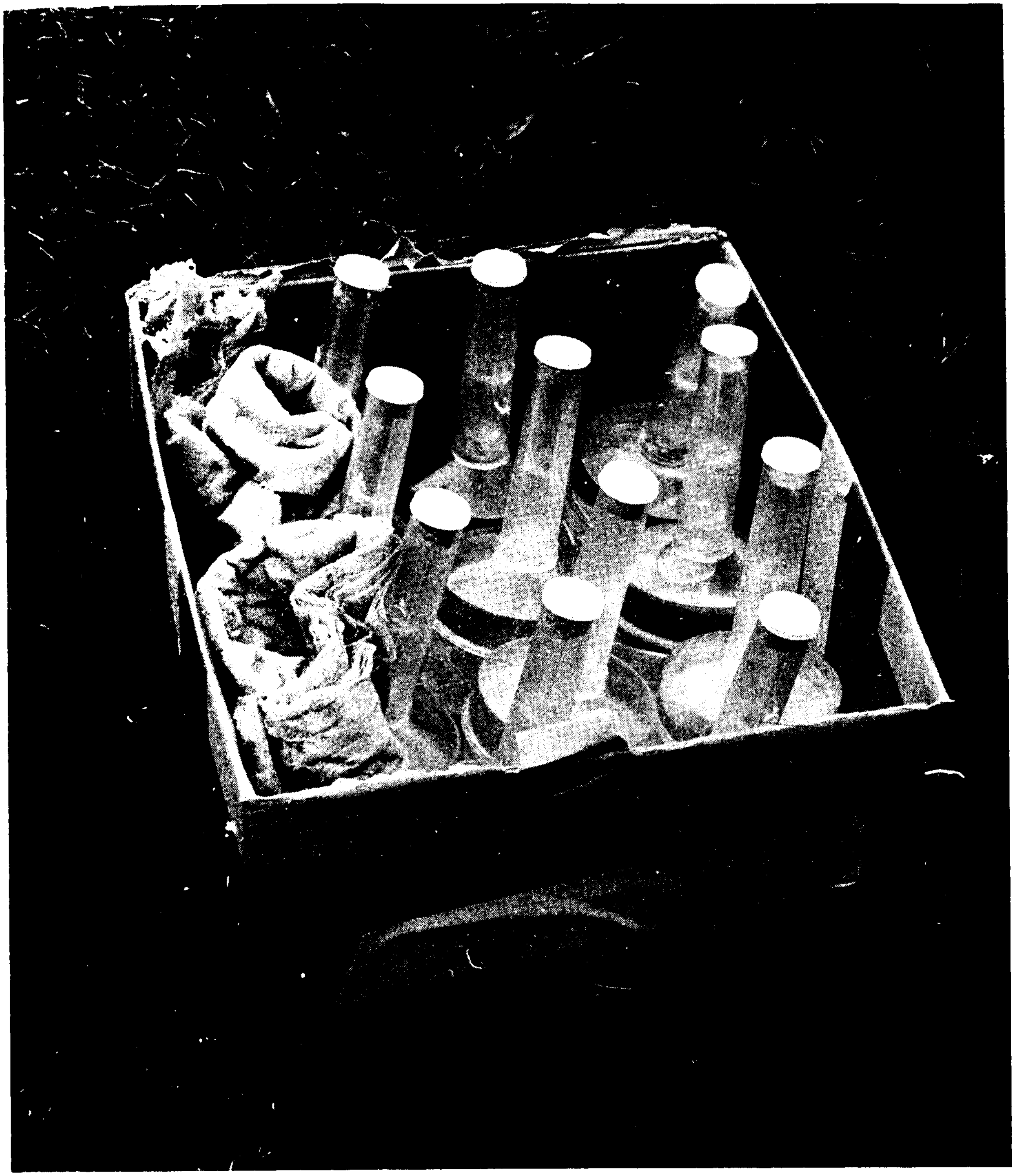
2. The amount of leaflets added to balance the scale is the amount to be carried on each balloon. This weight of leaflets can then be used to check each leaflet bundle as shown in the photo below. This assumes that all leaflet containers for this mission are the same weight. Many sizes of leaflets or other payload material can be used that require different payload containers. If a change is made, the total weight should be rechecked to make sure it is 2.991 kilograms.



3. The ballaster reservoirs are filled with alcohol to the point shown on the photograph below. This is a slow procedure and should be done well before balloon launching is to commence.

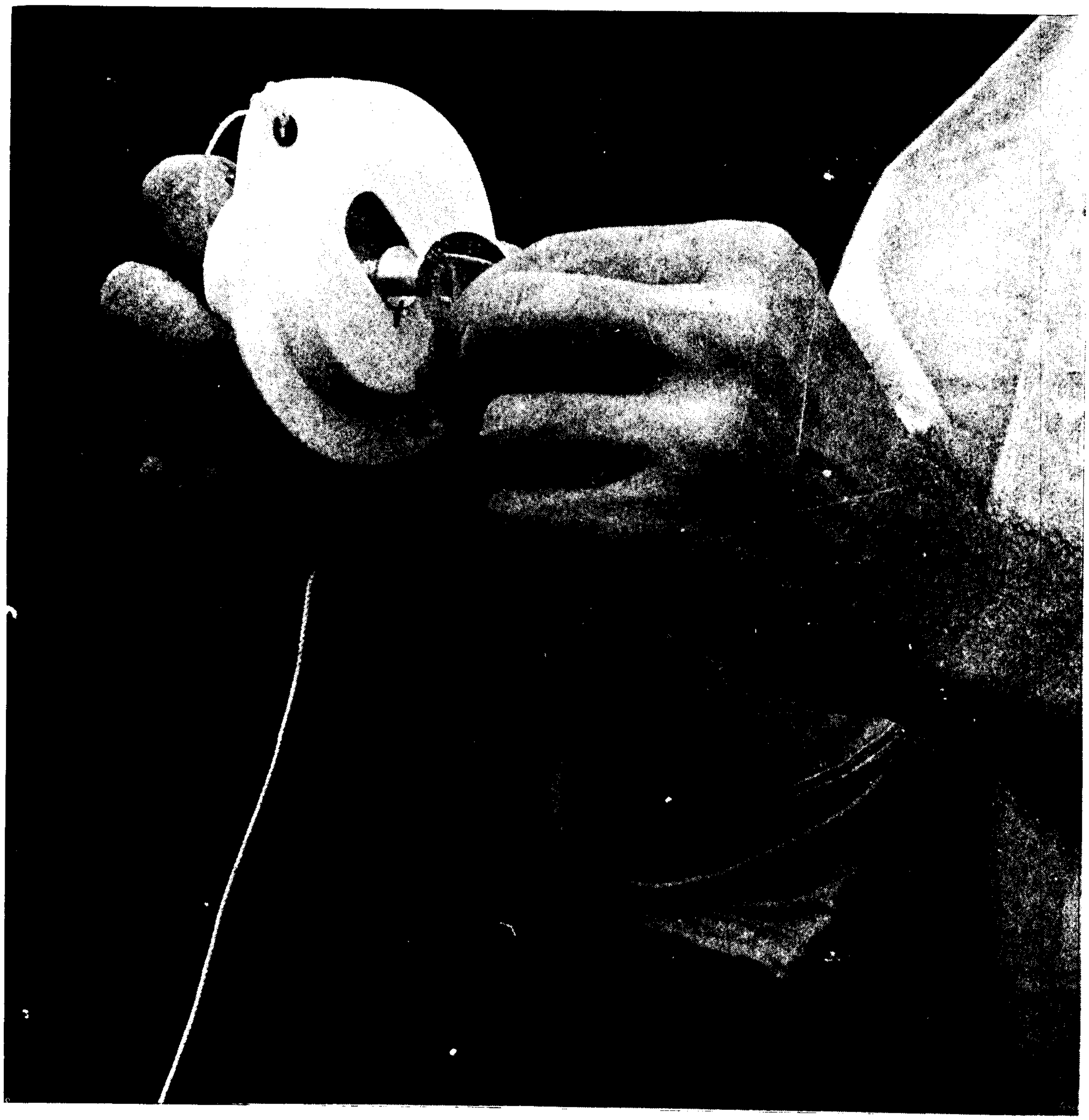


4. The ballaster with reservoirs full are then packed in containers for transport to the launch site. Any box will do, even a crude one as shown on the photo below. The ballasters should be cushioned to prevent damage.



5. The timers are set to the proper interval by inserting a coin in the end of the aluminum shaft and turning the shaft one revolution clockwise for each additional hour desired. Turn the shaft one revolution counterclockwise for each desired hour less than that preset. Fractions of an hour can be estimated. The mark on the shaft coincides with the mark on the case when the cord comes loose from the shaft at the end of the time period. Even hours should be added or subtracted from that preset, starting with these two marks coinciding.

Normally the clocks will be furnished with 8 hours preset. This can be checked by counting the number of turns of cord around the shaft. Since the shaft makes one revolution per hour, eight turns of cord around the shaft would require 8 hours of running time to unwind.



Of course, if the balance-tipping device is used instead of the timer, the balance device is checked for proper rigging as shown on page 17. The line for balloon tie-off and load suspension is precut to about 140 centimeters (about 5 feet). A loop is tied in one end large enough to serve as a hand hold. A quick snap fastener is tied to the other end. One cord is required for each balloon, and they should be prepared for transport to the launch site in a manner that will prevent tangling.

6. The proper number of balloons are selected. They should be left in their shipping containers until they are to be rigged for flying. The end fittings and stoppers are counted out and made ready for transport to the site.

7. Sand bag weights are prepared that are used in determining the correct amount of hydrogen in each balloon. There are two sand bag weights. The sand bag for attachment to the inflation nozzle weighs 2.991 + .299 — balloon weight — weight of nozzle — long plastic inflation hose and ground wire.

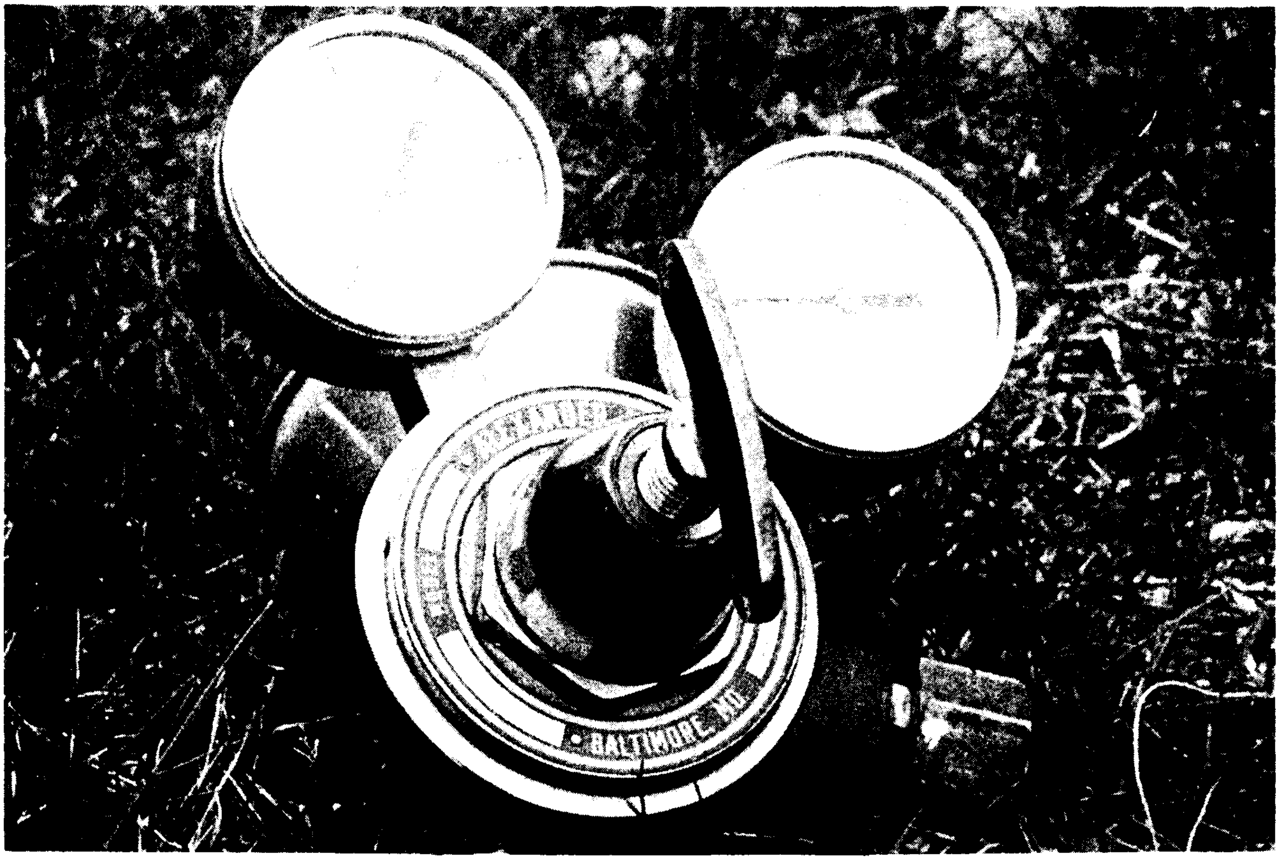
The sand bag for the final weigh-off check (described further below) weghs 2.991 + .299 — balloon weight.

At least two "nozzle sand bags" per inflation station should be prepared and at least three final check sand bags should be prepared.

8. A check list of all equipment should be made and each item checked off as it is placed in the vehicles for transport to the launch site.

9. Inflation equipment consists of:

A. pressure regulators (at least three per station, more if available)
B. inflation hose and nozzle (with electrical ground wire attached)
C. foot valve is optional but should be used if available (two per station)
D. sand bag weights (two nozzle weights, three final check weights per station)
E. protective ground cloth (two per station)
F. wrenches for regulator attachment and removal, and a screw driver for tightening hose clamps. (One set of wrenches for each two regulators)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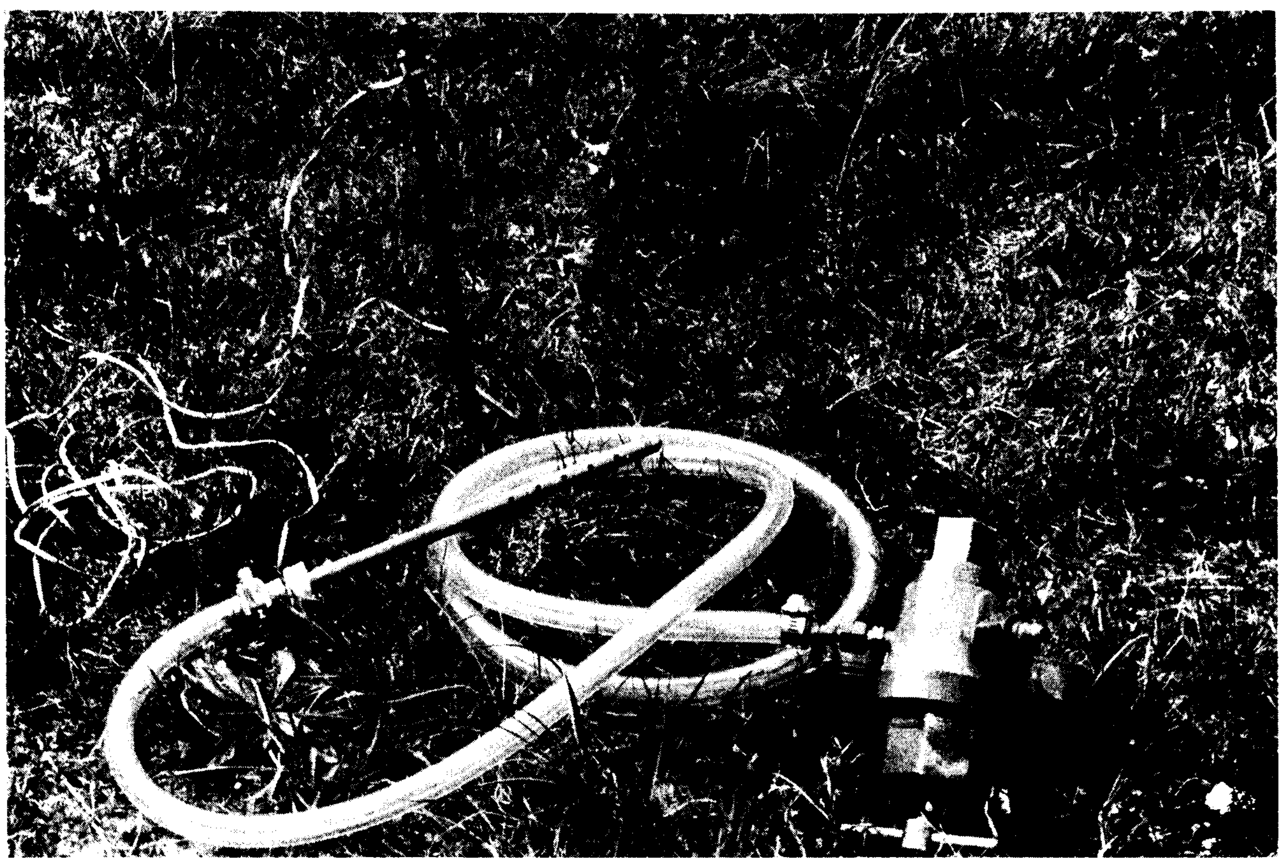
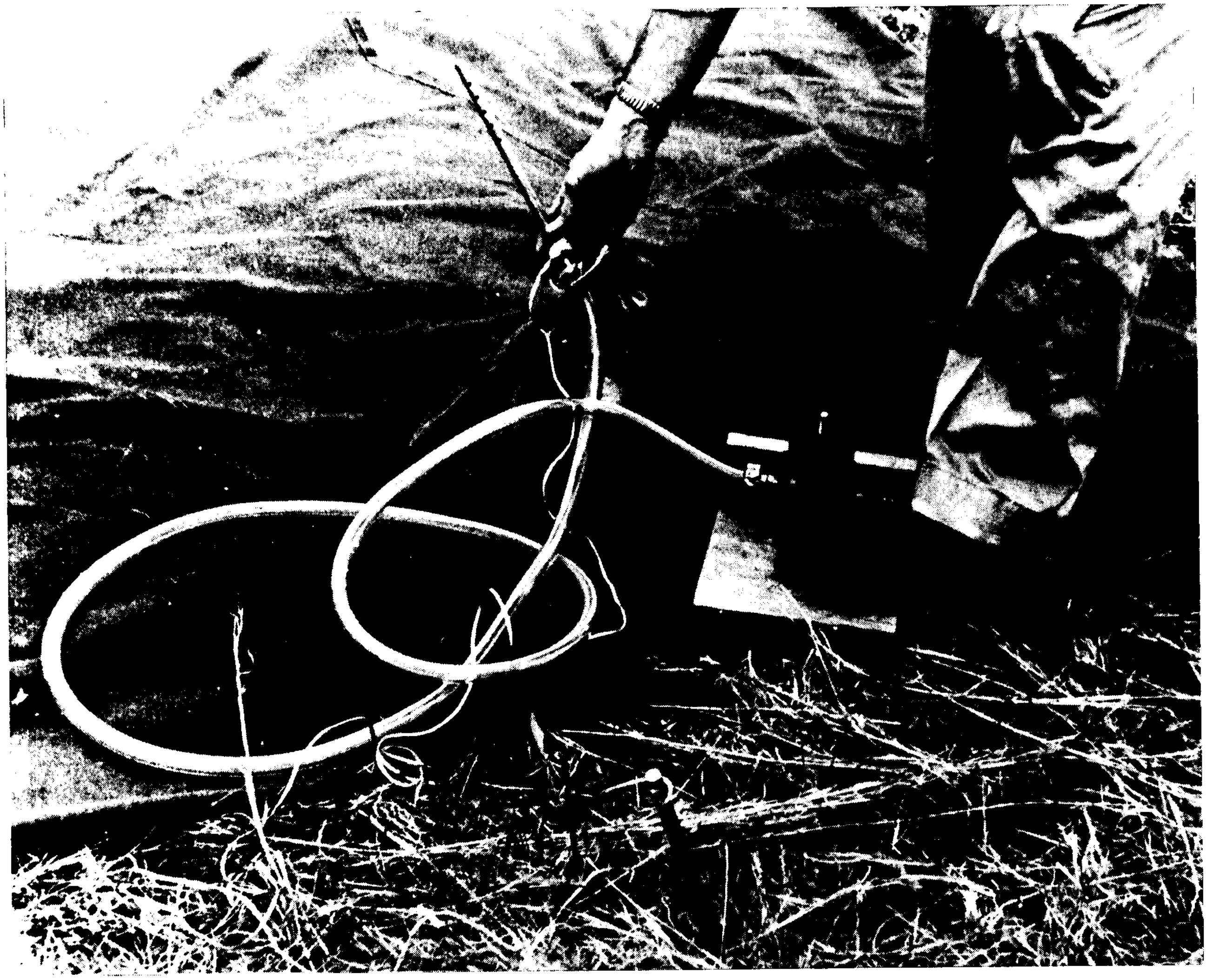
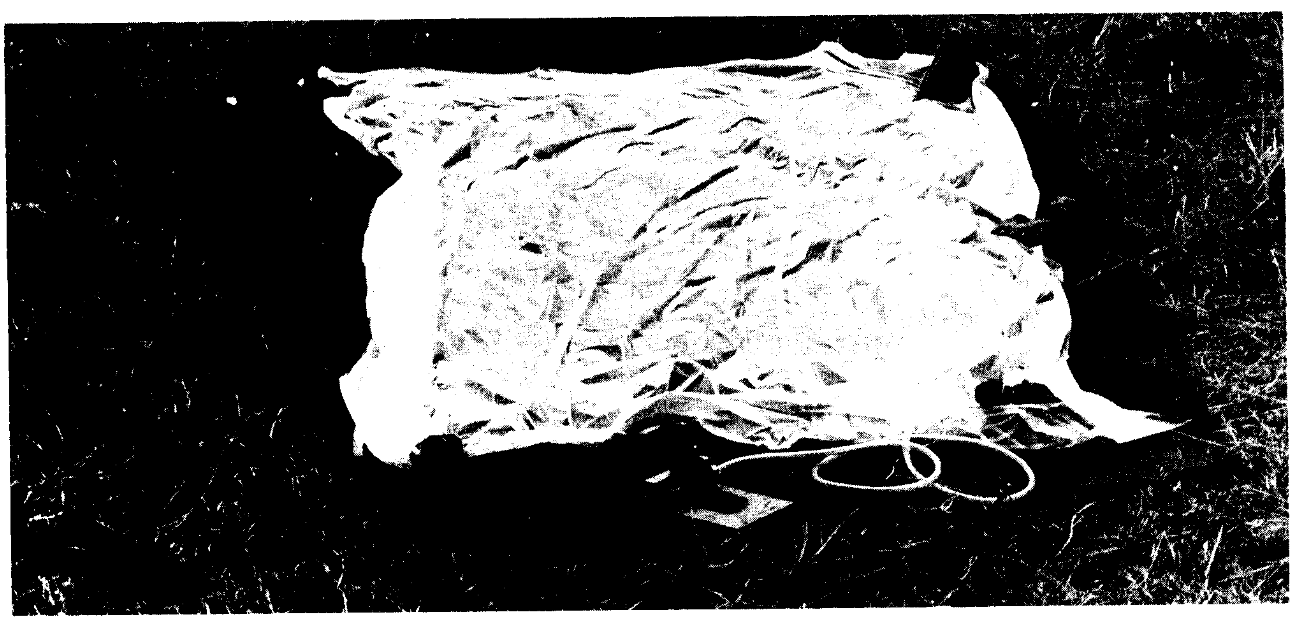




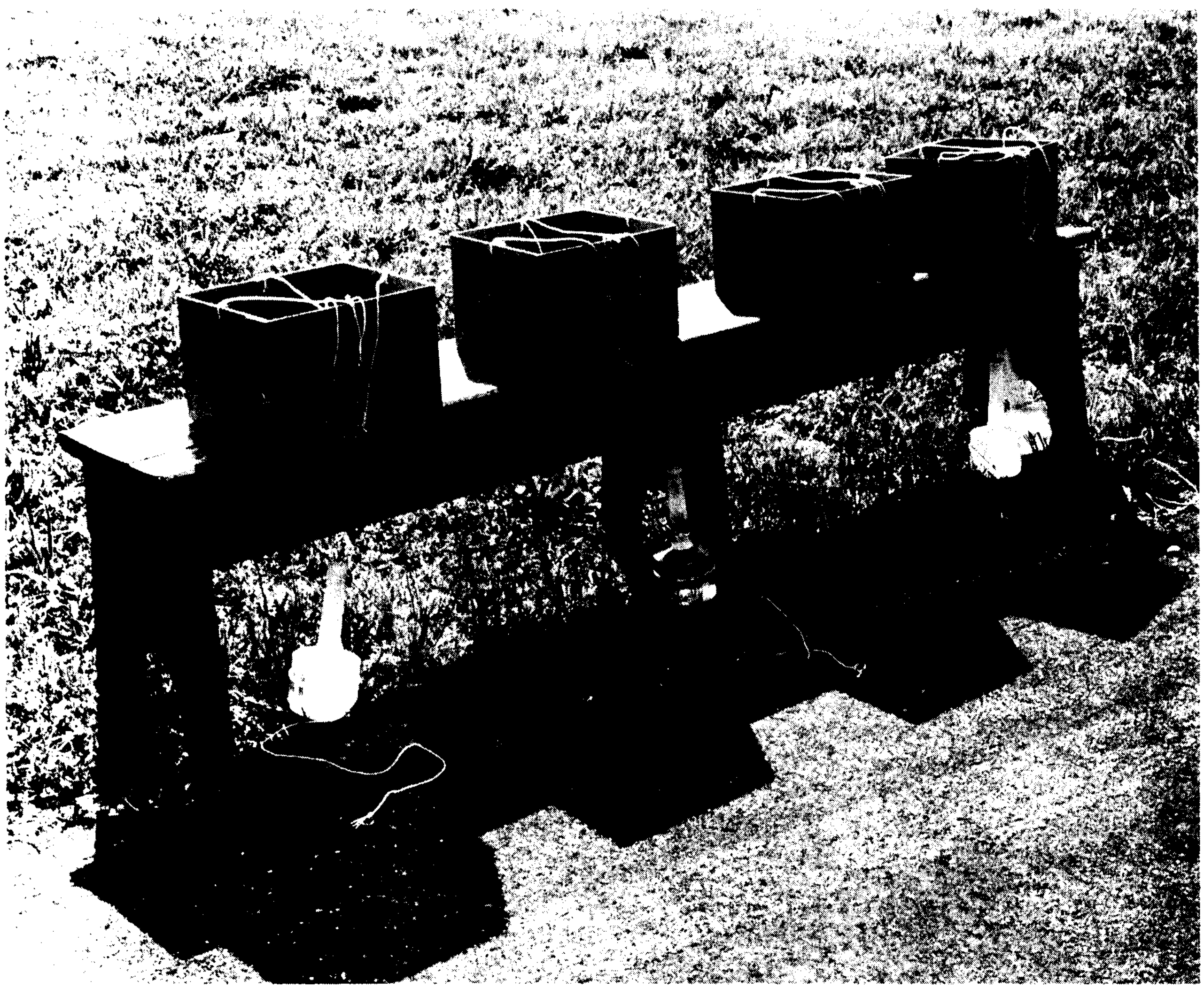


G. High pressure manifold equipment — If a manifold is used to connect the gas cylinders together, it is assembled long before the launch period and all connections checked for gas tightness. The photo below shows a 12 cylinder manifold with 9 cylinders connected together. The cylinder valves are opened and the regulator and inflation nozzle used as with a single cylinder. If many regulators are used instead of a manifold, it would be advisable to check all cylinder valve threads ahead of time to insure that rapid changing of the regulators can be accomplished.

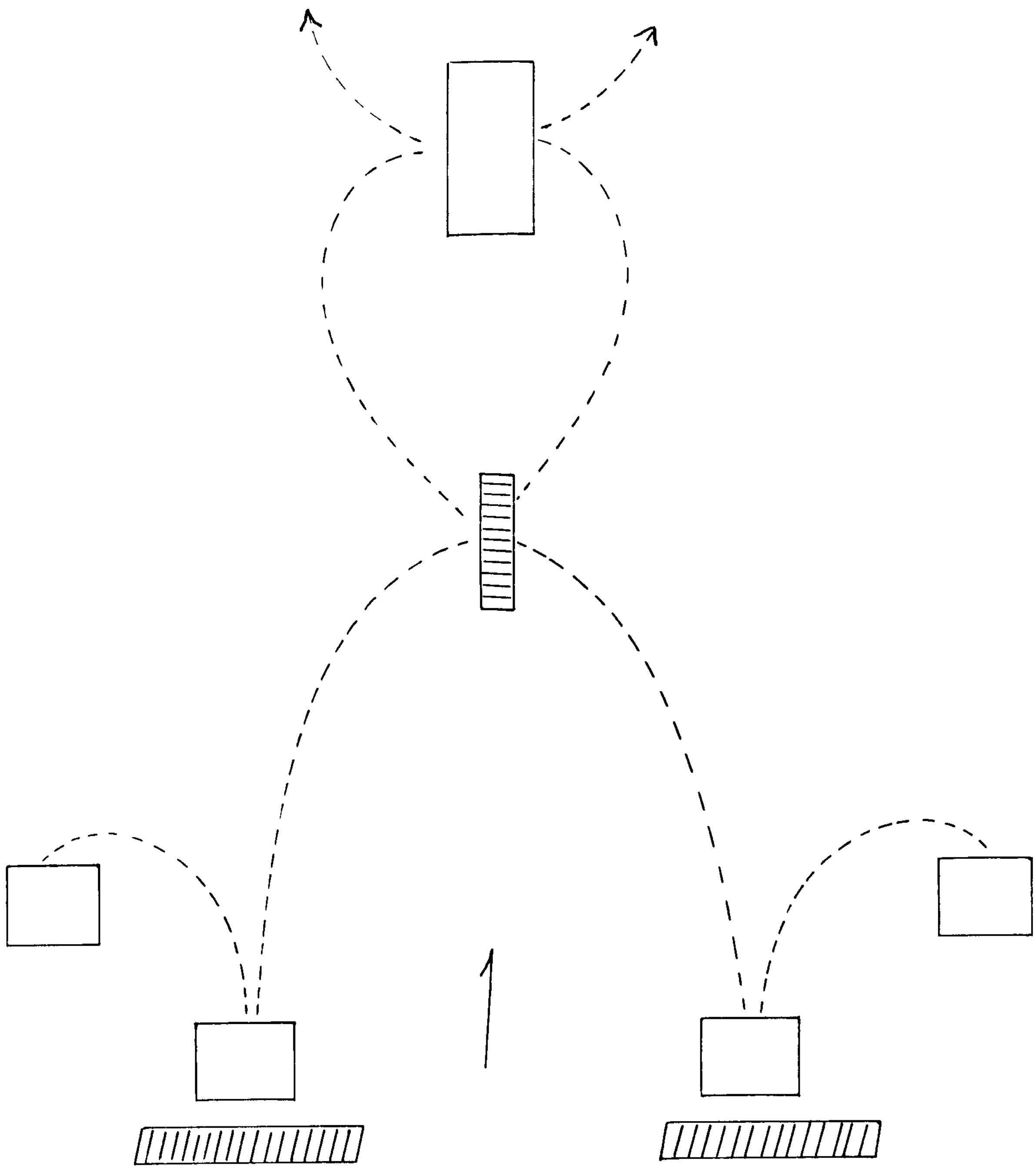
10. An inflation station as described here means the area where one launching crew rigs, inflates, and launches the balloons. There may be many crews and many such stations depending on the desired rate of launching and facilities available. The inflation station at the launch site has the necessary hydrogen cylinders ready for the mission. The site itself may have been chosen because it is sheltered from prevailing winds and has an area of about 50 meters down wind that is clear of obstructions that could snag a balloon.

It is expected that all equipment except the hydrogen would be stored elsewhere and transported to the launch site as described above a few hours before launching time. It is important that all equipment be prerigged as much as possible to save time once the launching period has started.

At the inflation station, two ground cloths are laid out; one is for rigging the balloon, and one for inflating the balloon. The payloads and ballasters are set up on a special bench. Alcohol is made available for the final filling or topping off of the ballaster. This bench allows working space and storage space for the payload equipment. A simple arrangement is shown below.



The launch site is laid out essentially in accordance with the diagram below.



Part III

(Final Rigging and Launching)

The balloon is laid out flat on a protective ground cloth that is placed for the sole purpose of rigging the balloons. Starting at one corner of the bottom of the balloon (the open end) the material is gathered together carefully, working toward the other bottom corner. Midway along the bottom the plastic end fitting is inserted to serve as an inflation tube later on (picture below).

The bottom of the balloon is completely gathered around the inflation tube except for the last 3 inches. The gathered material is tied off using a line prerigged for the purpose (see paragraph 5 above.). The base is tied off tightly leaving about 30 centimeters of line to the quick-snap end and about 1 meter to the loop end of the cord. The sketch, page 16, shows this arrangement.

The balloon when so rigged is ready for inflation. During the inflation process, sand bag weights are used to check for the correct amount of lift. The cork is removed from the inflation tube and the nozzle inserted through the tube until the end of the tube bears on a rubber ring on the lower part of the nozzle. This rubber ring seals off any flow of air into the balloon during the inflation process.

It is important to review safety considerations before the flow of hydrogen is allowed. The inflation crew must wear protective clothing and goggles. The clothing must be cotton; no silk, fur or nylon can be worn. All inflation equipment must be electrically grounded. **There is no smoking in the area.** When all safety precautions are checked, inflation can begin.

Hydrogen is allowed to flow into the balloon. One man holds the balloon and the nozzle and determines when the proper amount of hydrogen is in the balloon. If there is a surface wind, a second man may help him control the balloon during the first part of the inflation. When the balloon will lift the sand bag on the nozzle, it is correctly inflated. The nozzle is removed, the cork inserted, and the final check sand bag attached to the quick snap end of the tie off line on the base of the balloon. One man then determines if the lift in the balloon is correct. If the balloon is in neutral bouyancy with the final check sand bag or if it very slowly ascends or descends when this weight is attached it is correctly inflated. If there is a surface wind it will be necessary to run with the balloon at the speed of the wind to check for correct inflation. If under inflated, the balloon is brought to the second inflation station, the cork removed, the nozzle inserted, and more gas added. The balloon is checked again with a final check sand bag. If over inflated the balloon is launched with payload. It is not safe to try to remove hydrogen from an inflated balloon.

The correctly inflated balloon is brought to the payload station. One man is ready with a filled ballaster and final payload rigging. The ballaster has just been "topped off." It is free of bubbles. The sand bag is removed from the quick snap and the payload rig attached. The trip line to the bottom of the payload container is tied into the quick snap. The balloon launcher gently releases the balloon. If there is surface wind, the launcher should run with the wind to more gently launch the balloon.

It is important that the balloon be correctly weighed off. It should not rise too fast. If it sways back and forth after launch, it is rising too fast and contains too much hydrogen. Recheck all sand bag weights if this happens. The balloon should rise very slowly without swaying back and forth.

Teamwork is necessary for rapid launching of the balloons. When one man has released a balloon he returns to rig, inflate, and launch another. Each station should have about eight men. One man handles all the inflations, one rigs ballasters and payloads. The others keep a steady stream of balloons going into the air.

After the last balloon has been launched, a record is made of the number of balloons launched, the size and weight of the leaflets, and the time period of the launching. This will enable a post analysis made by the meteorologist to determine where the balloon and leaflets descended. This post analysis completes the mission.

Part IV

Medium Altitude Balloon for Leafleting at 3048 Meters Altitude (10,000 feet)

1. The medium altitude balloon is slightly smaller than the high altitude one described above. It has a volume of 7.08 cubic meters (250 cu. ft.). It measures about 3.05 meters by 2.84 meters (10 x 12.5 ft.) when spread out flat. Even though smaller it will carry a larger payload because it floats at a lower altitude. The payload weight is usually about 2.99 kilograms (8 pounds).

2. Every step in rigging and launching this balloon is the same as those steps described previously for the other balloon. The timer may be used instead of the tip balance device and the sand bag weights are different. The weight of all components that compose the medium altitude system is 5.543 kilograms. In step one, this is the weight preset on the weighing scale. The final check sand bag weight weighs 5.543 kilograms + .554 kilograms balloon weight. The sand bag that is attached to the inflation nozzle weighs 5.543 kilograms + .554 kilograms — balloon weight — weight of nozzle, hose and ground wire.

The final topping off of the ballaster is done by removing the float, holding the thumb over the large hole in the float chamber and filling the chamber about three-fourths full of alcohol. The float is then inserted, the cap replaced and the ballaster inverted. With practice this operation can be done without allowing bubbles of air into the ballaster reservoir. For the medium altitude flights these bubbles are unimportant but for high altitude flights they will decrease the floating time of the balloon if too many bubbles occur. This is so because each bubble expands about four times from the surface to 12,192 meters.

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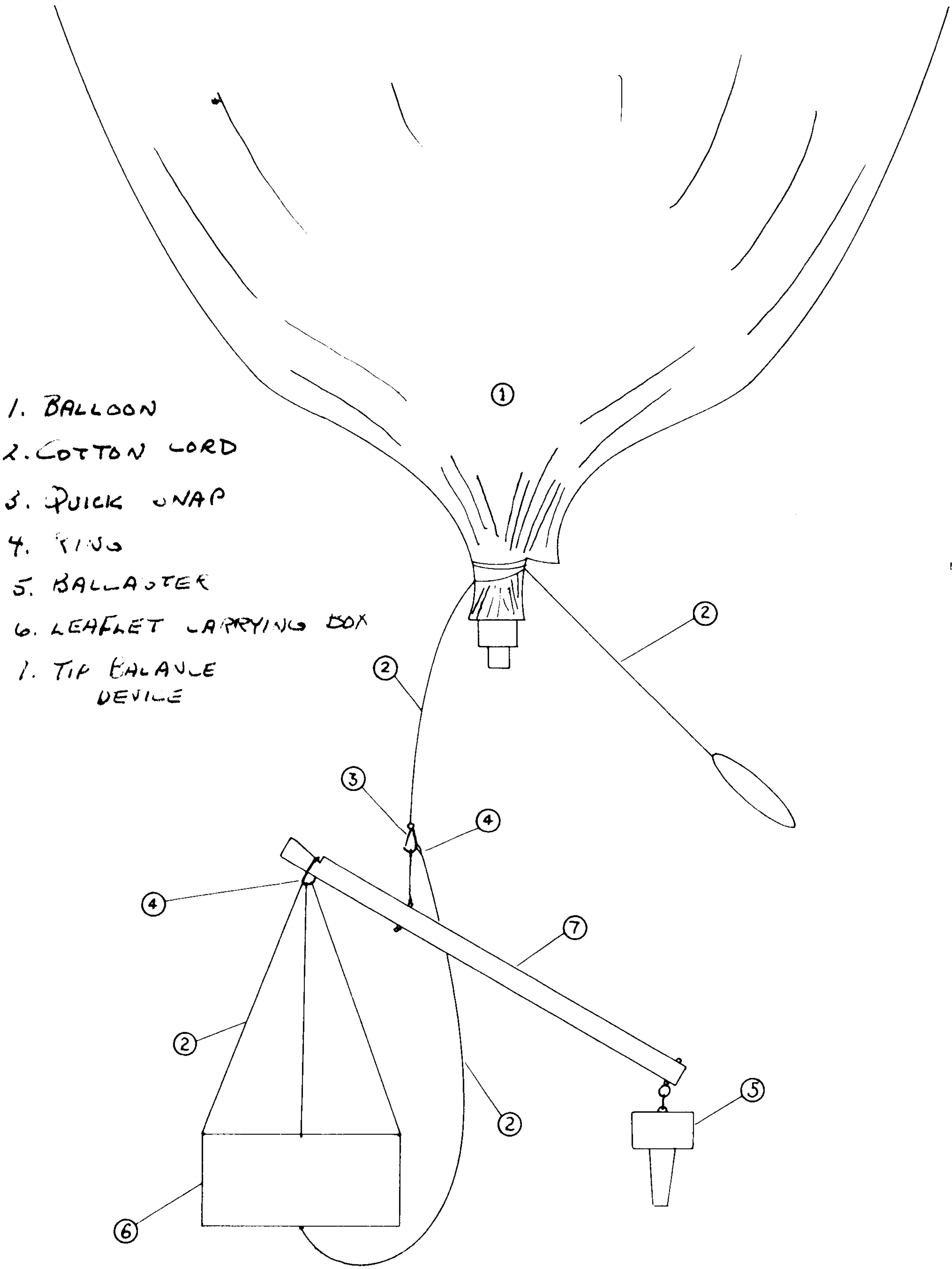

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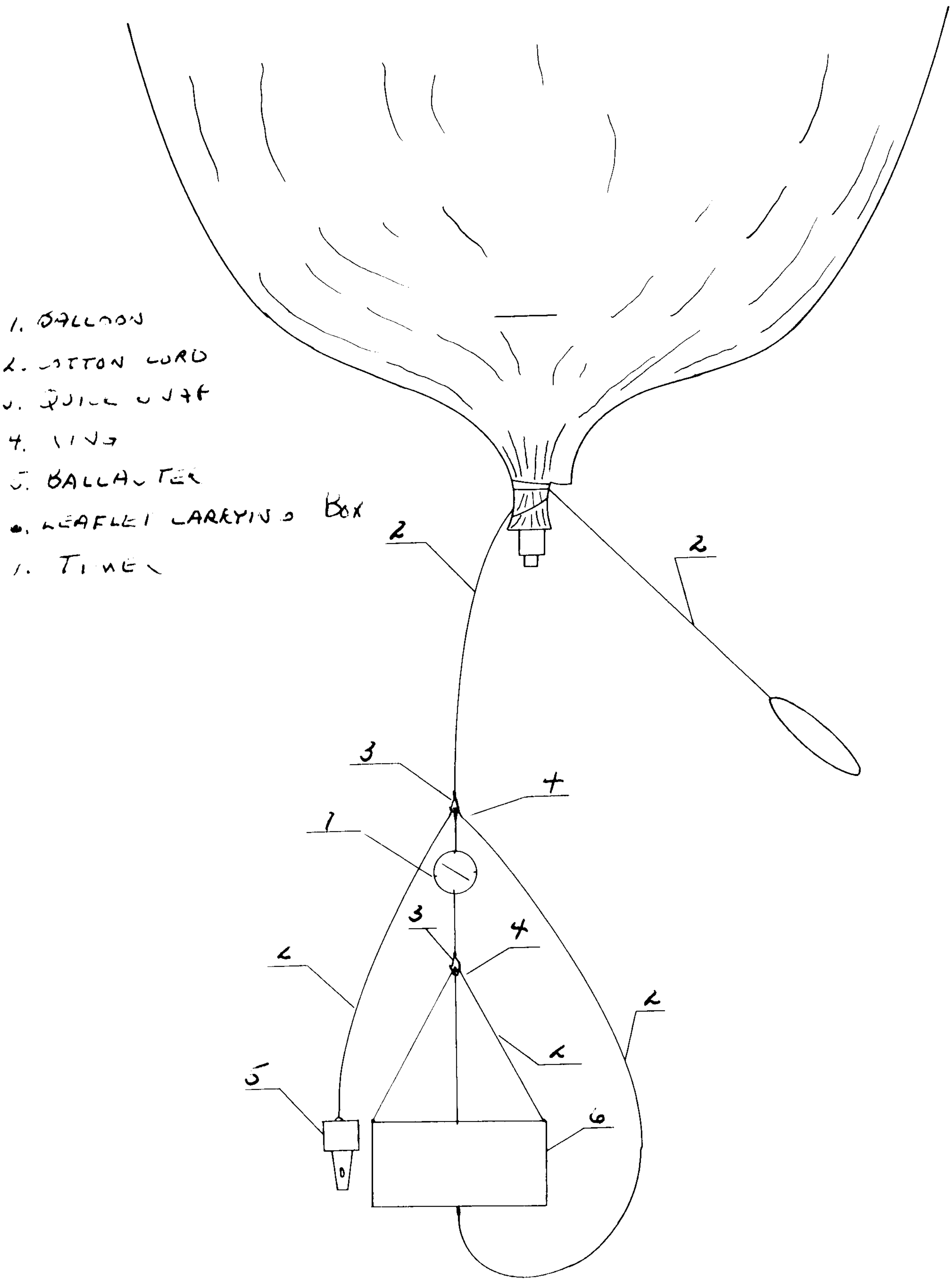

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