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A Blacksmith's Bellows

by: A. Inversin and D. Sanguine

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A BLACKSMITH'S BELLOWS

DESIGNED BY
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UNIVERSITY OF TECHNOLOGY
LAE, PAPUA NEW GUINEA

DECEMBER 1977

SOUTH PACIFIC
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A BLACKSMITH'S BELLOWS

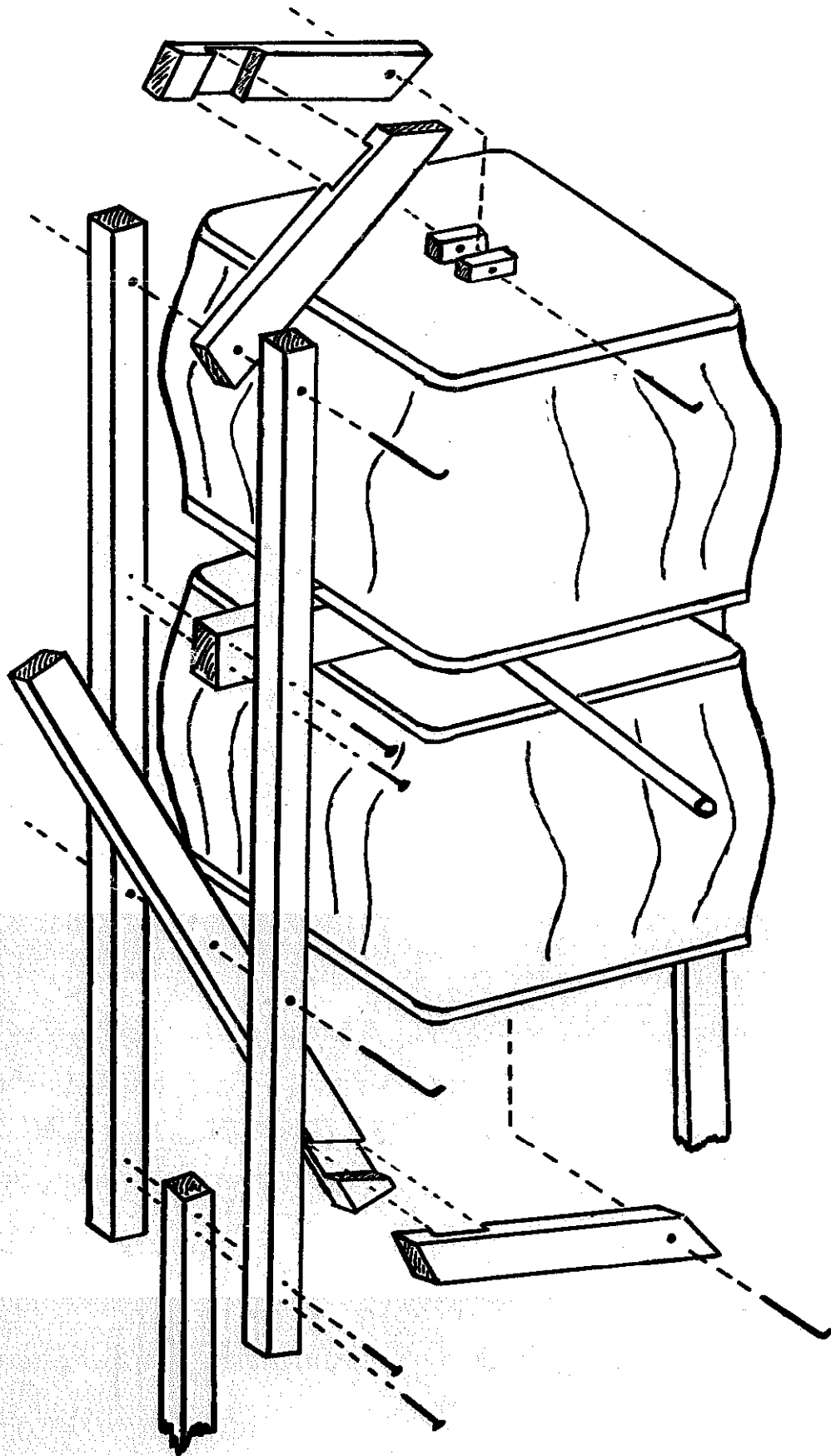
Designed by A.R. INVERSIN

UNIVERSITY OF TECHNOLOGY

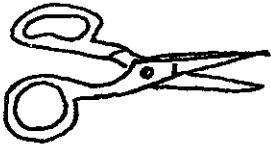
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Drawings by DAVID SANGWINE

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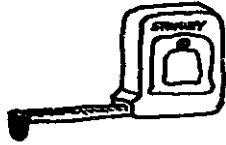
TOOLS



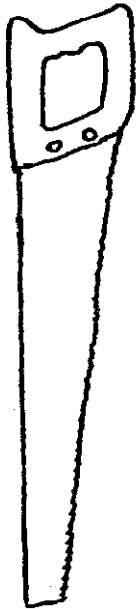
SCISSORS



HAMMER



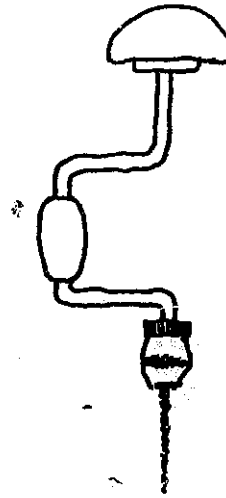
TAPE MEASURE



SAW



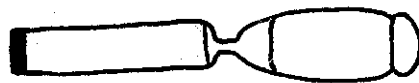
METAL FILE



DRILL WITH
6 mm. (1/4 in.) BIT



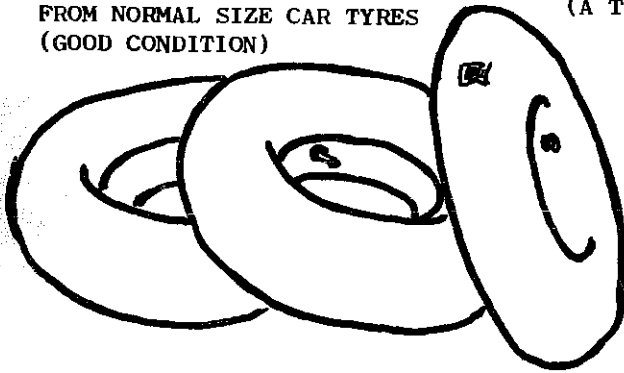
TIN SNIPS



CHISEL

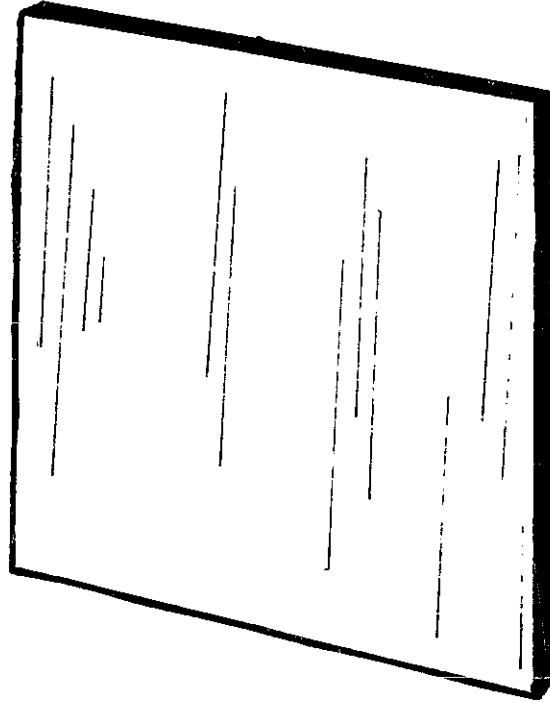
MATERIALS

2 INNER TUBES
FROM NORMAL SIZE CAR TYRES
(GOOD CONDITION)

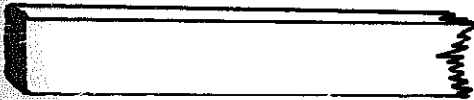


1 INNER TUBE FOR CUTTING
(A TRUCK TUBE IS GOOD)

PLYWOOD ABOUT 12 mm. ($\frac{1}{2}$ in.) THICK
1 METRE x 1 METRE (4 ft. x 4 ft.)



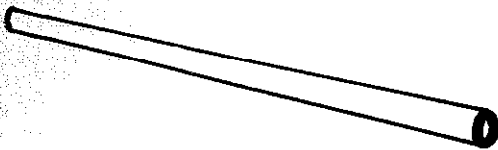
PIECES OF WOOD ABOUT 5 cm. (2 in.) WIDE
AND 2 cm. (1 in.) THICK
ENOUGH TO MAKE ABOUT 6 METRES (20 ft.)



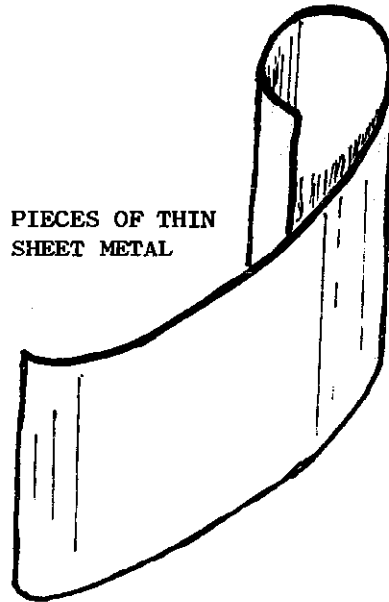
ABOUT 40 4 cm. ($\frac{1}{2}$ in.) NAILS

ABOUT 200 2 cm. ($\frac{3}{4}$ in.) NAILS

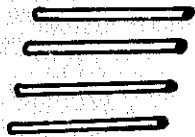
2 cm. ($\frac{3}{4}$ in.) STEEL PIPE
ABOUT 60 cm. (2 ft.) LONG



PIECES OF THIN
SHEET METAL

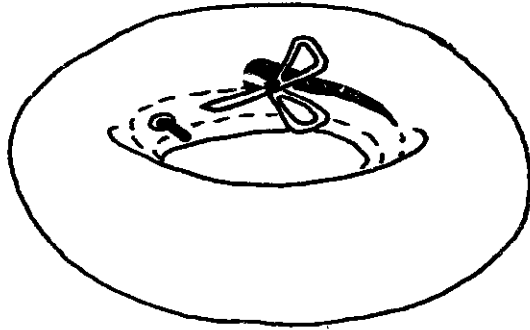


6 mm. ($\frac{1}{4}$ in.) METAL ROD
4 PIECES EACH ABOUT 10 cm. (4 in.) LONG



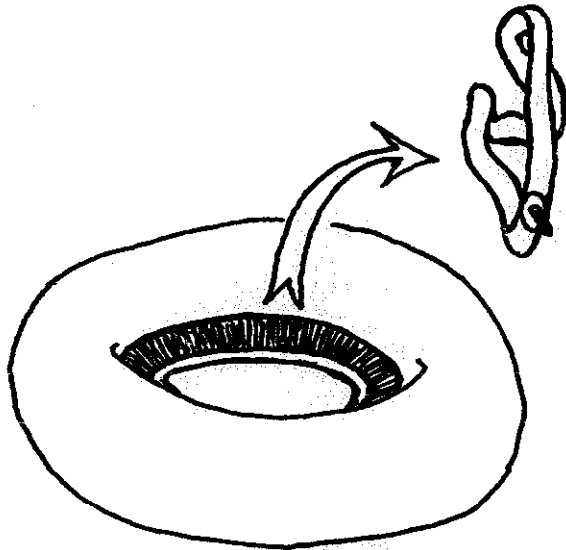
BUILDING THE BELLOWS

1



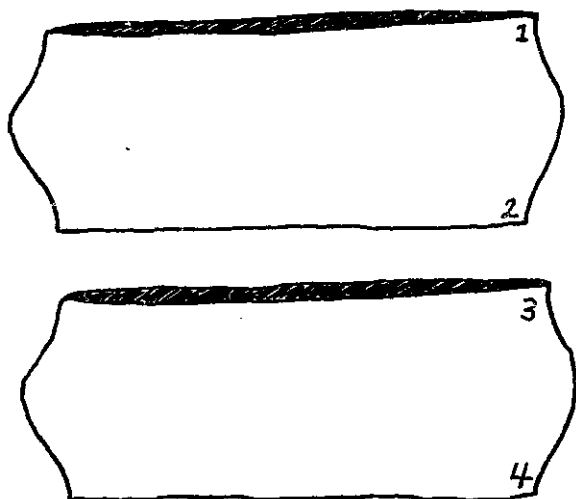
CUT A STRIP FROM
2 OLD CAR INNER TUBES.

2



THROW AWAY THE STRIPS.

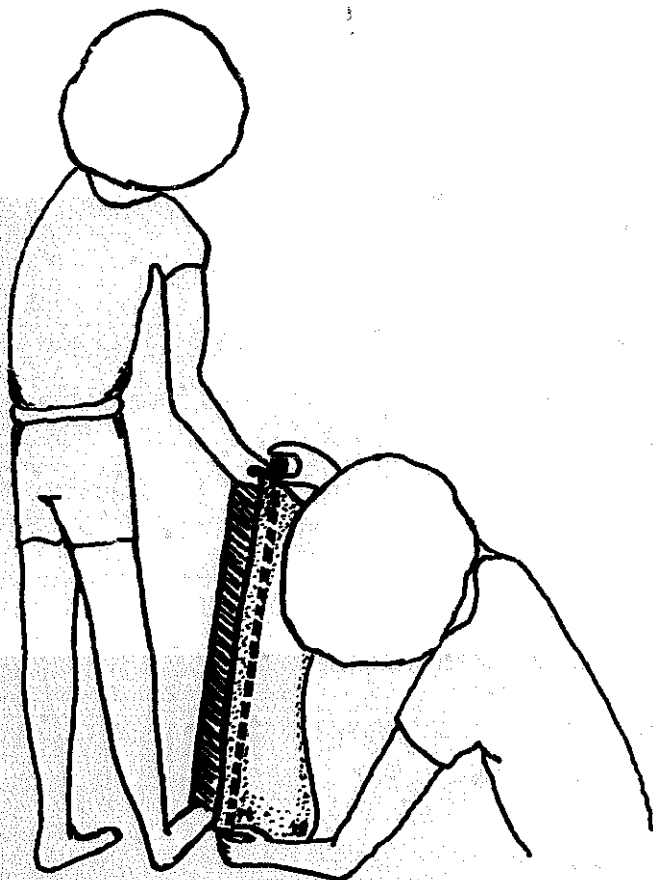
3



OPEN OUT THE TUBES LIKE THIS.

NUMBER EACH OPENING.

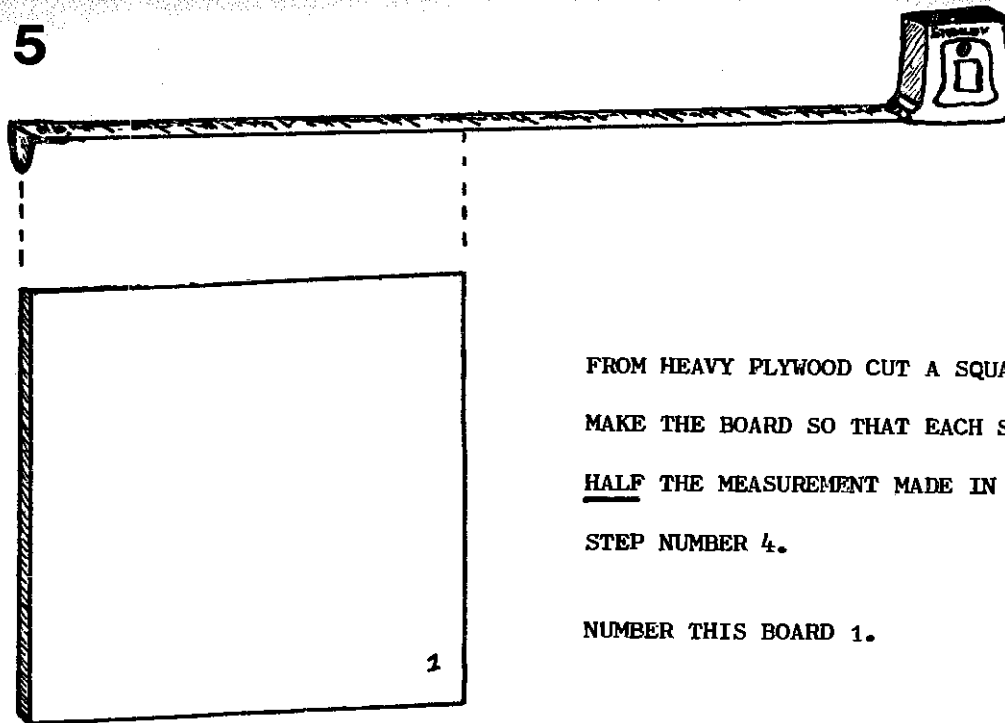
4



PULL OPENING NUMBER 1 TIGHTLY
AND MEASURE ONE SIDE.



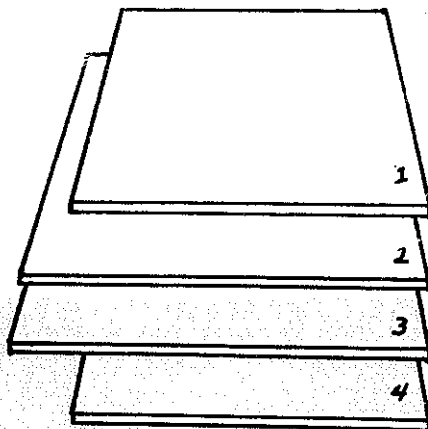
5



FROM HEAVY PLYWOOD CUT A SQUARE BOARD.
MAKE THE BOARD SO THAT EACH SIDE IS
HALF THE MEASUREMENT MADE IN
STEP NUMBER 4.

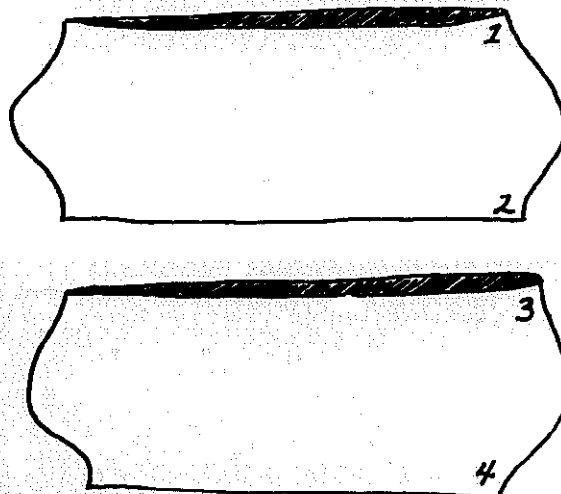
NUMBER THIS BOARD 1.

6



CUT 3 MORE BOARDS IN THE SAME WAY
FOR OPENINGS NUMBER 2, 3 AND 4.

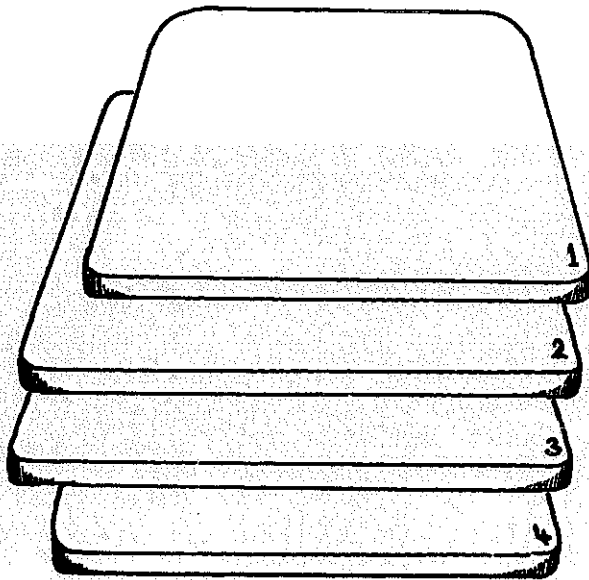
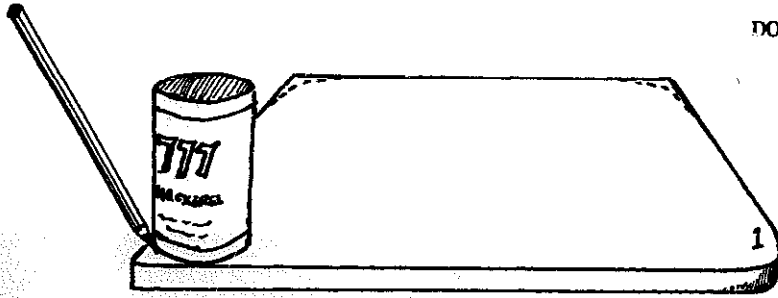
NUMBER EACH BOARD.



7

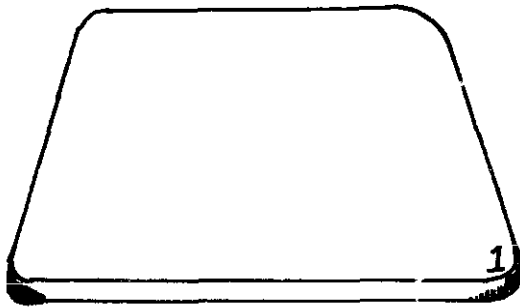
MAKE THE CORNERS ROUND.

DON'T CUT OFF TOO MUCH.

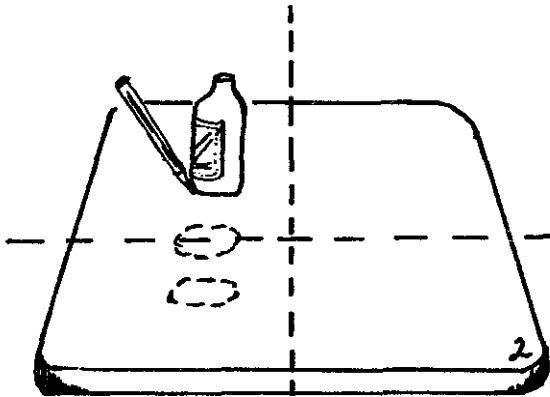


8

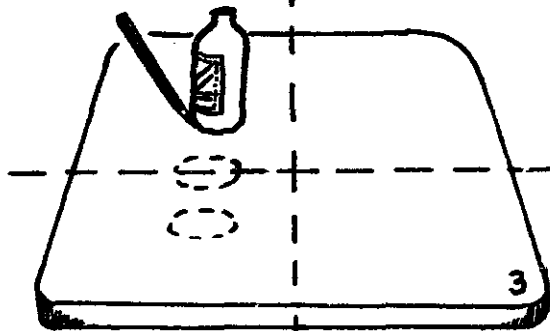
IN BOARDS NUMBER 2, 3 and 4,
CUT 5 cm. (2 in.) HOLES
FOR THE AIR TO PASS THROUGH.



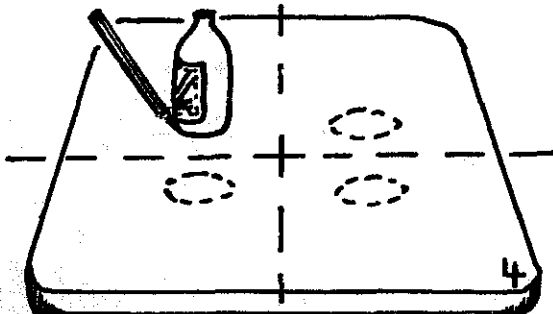
NO HOLES



2 OR 3 HOLES

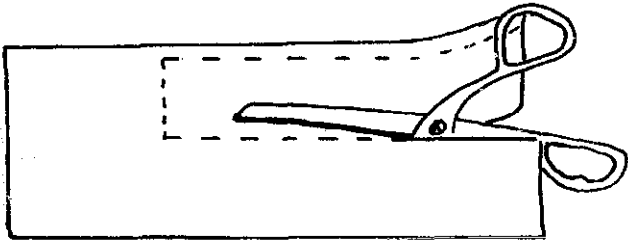


3 HOLES



4 HOLES

9

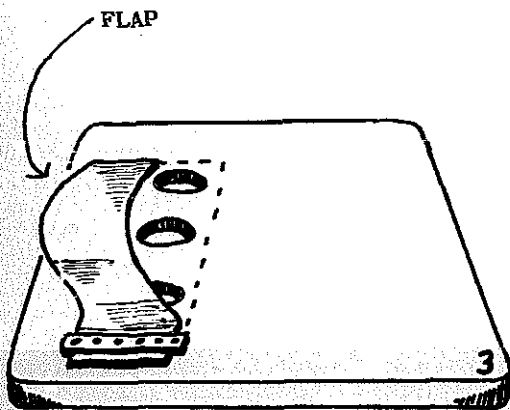


CUT 3 PIECES OF HEAVY RUBBER
TO MAKE FLAPS.

MAKE THEM BIG ENOUGH
TO COVER THE HOLES

AS SHOWN IN STEP NUMBER 10.

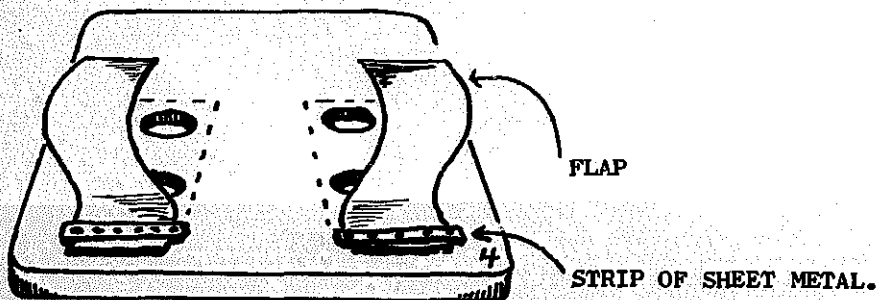
10

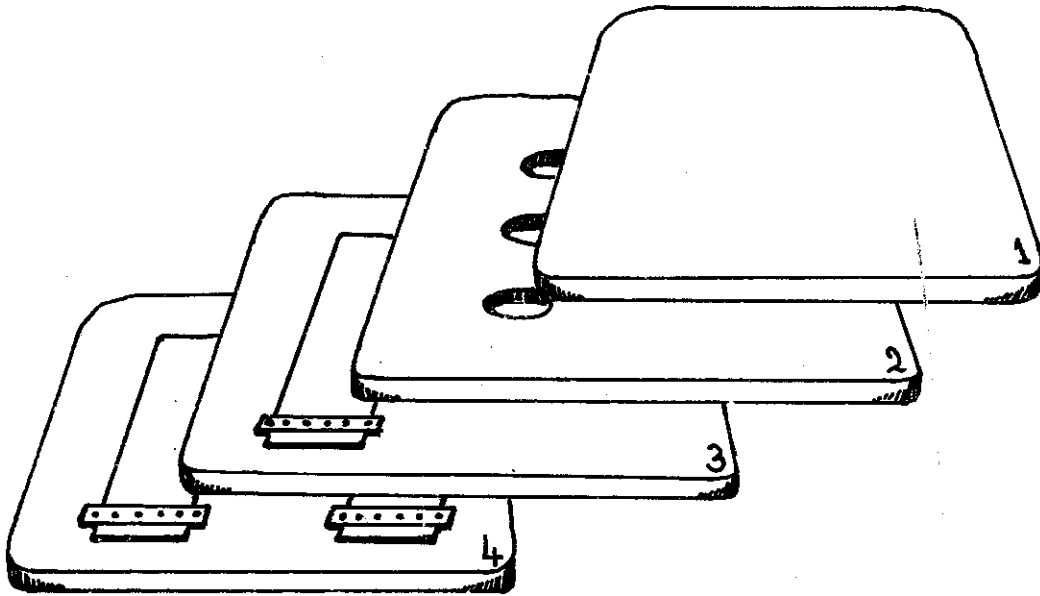


USE A STRIP OF SHEET METAL

TO NAIL THE RUBBER FLAPS OVER THE HOLES

IN BOARDS NUMBER 3 AND 4.



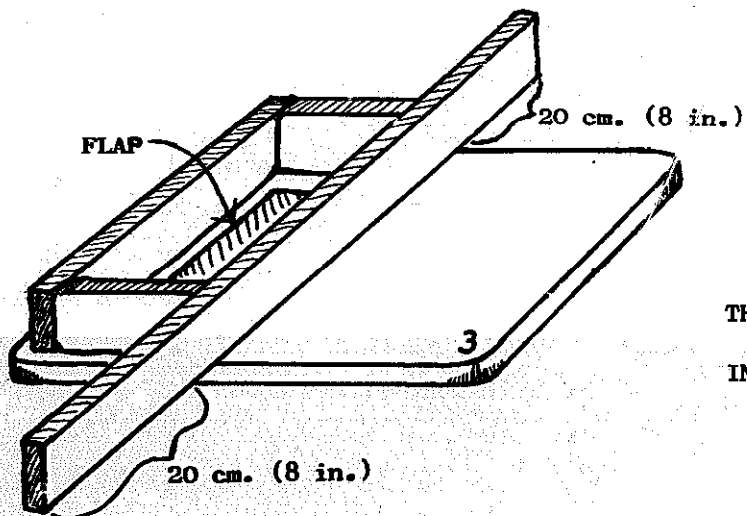


NOW THE BOARDS SHOULD LOOK LIKE THIS.

11

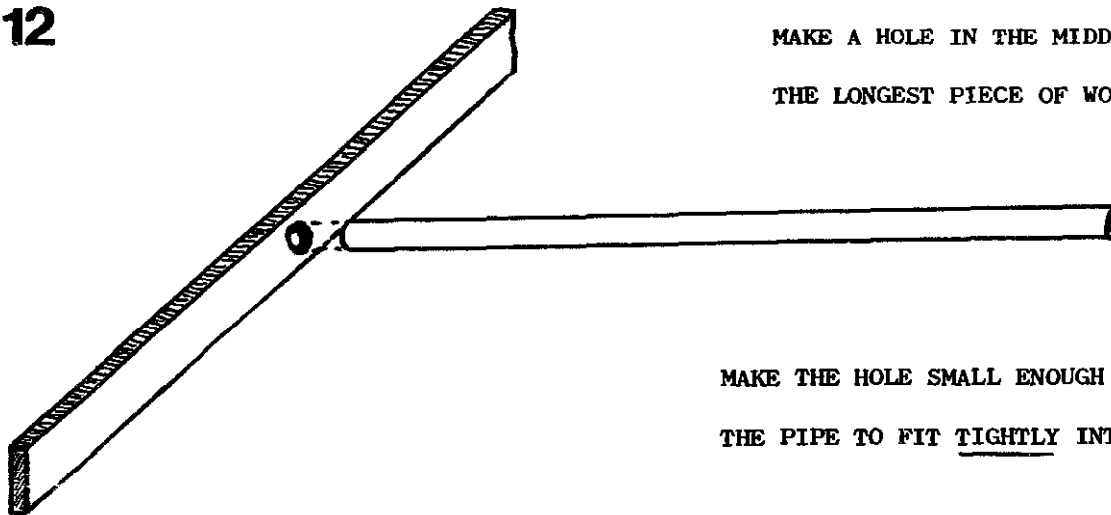
CUT 4 PIECES FROM THE 5 cm. x 2 cm. WOOD.

CUT THEM SO THEY WILL MAKE A BOX
LIKE THIS TO FIT AROUND THE FLAP
ON BOARD NUMBER 3.



THE LONG PIECE WILL GO
IN THE MIDDLE OF THIS BOARD.

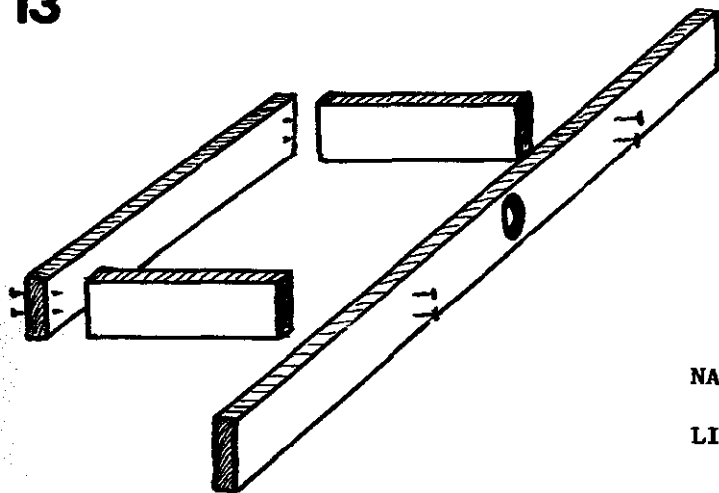
12



MAKE A HOLE IN THE MIDDLE OF
THE LONGEST PIECE OF WOOD.

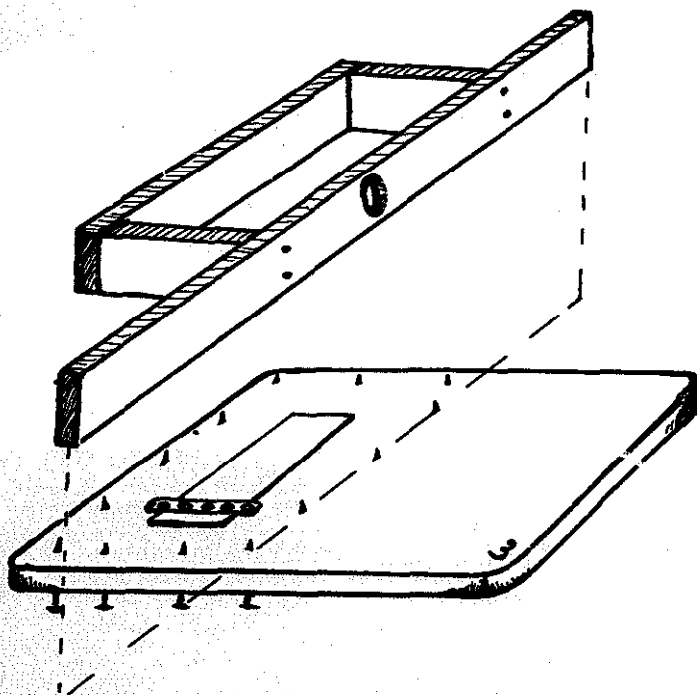
MAKE THE HOLE SMALL ENOUGH FOR
THE PIPE TO FIT TIGHTLY INTO IT.

13



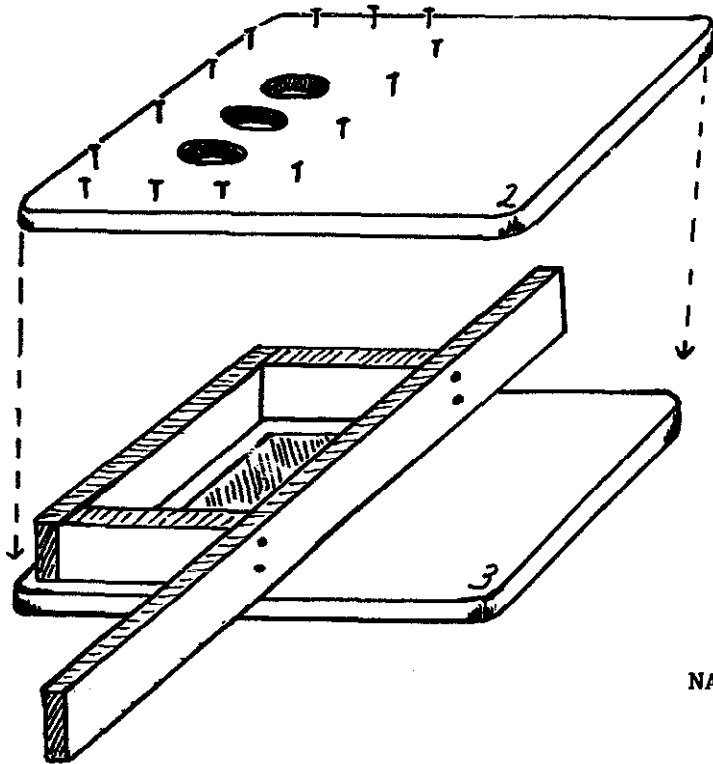
NAIL THE 4 PIECES OF WOOD TOGETHER
LIKE THIS.

14

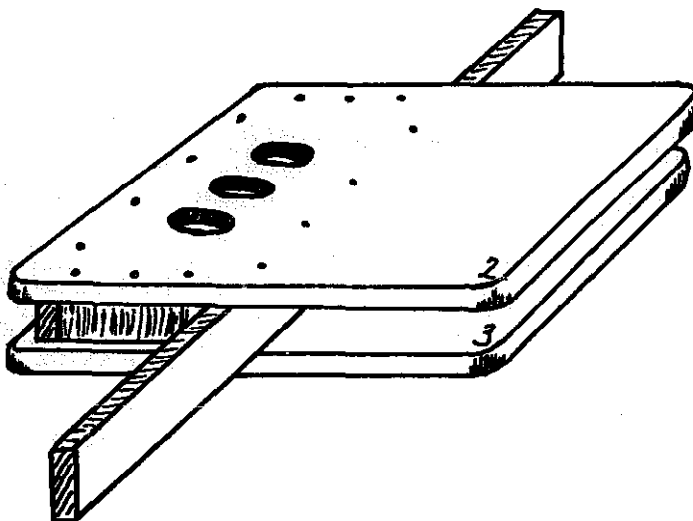


NAIL THE BOX
TO BOARD NUMBER 3.

15



NAIL BOARD NUMBER 2 OVER THE BOX.

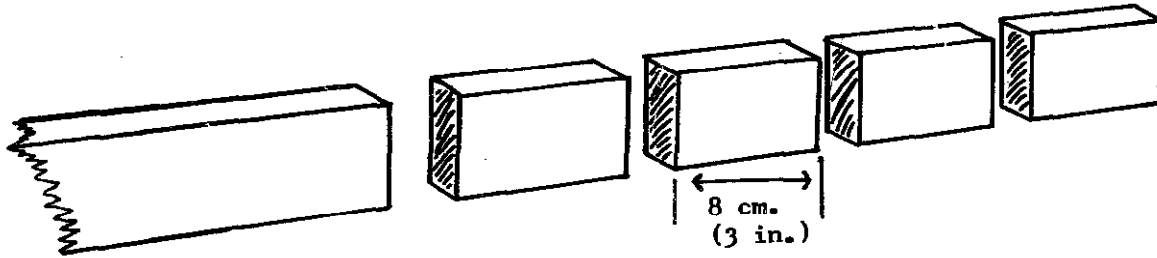


NOW IT LOOKS LIKE THIS.

THIS BOX SHOULD BE WELL MADE
WITH AIR-TIGHT JOINS.
USE CARPENTER'S GLUE OR
GUM FROM THE BUSH.

16

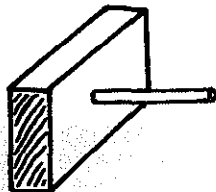
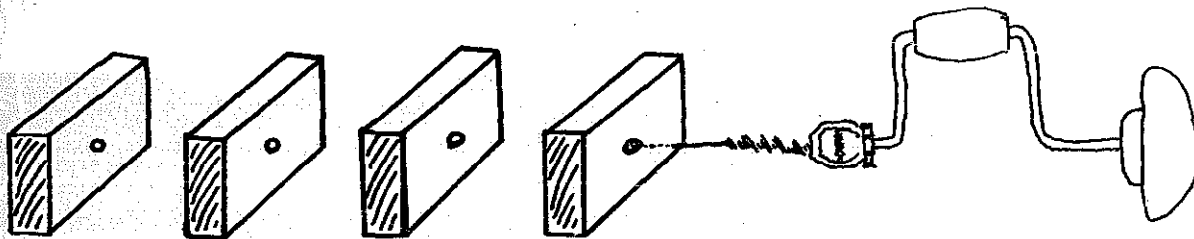
CUT 4 SMALL PIECES FROM THE
5 cm. x 2 cm. WOOD.



EACH PIECE SHOULD BE ABOUT 8 cm. (3 in.) LONG.

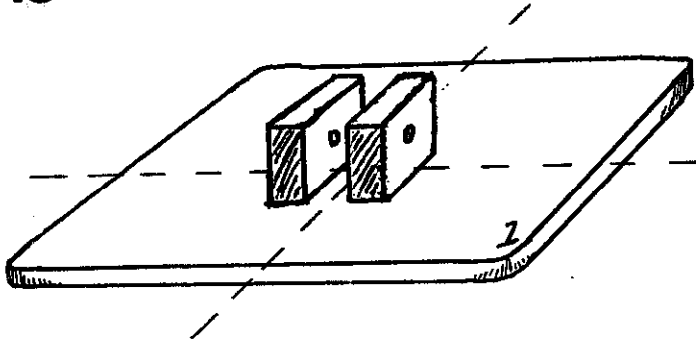
17

DRILL A HOLE THROUGH
THE CENTRE OF EACH PIECE.



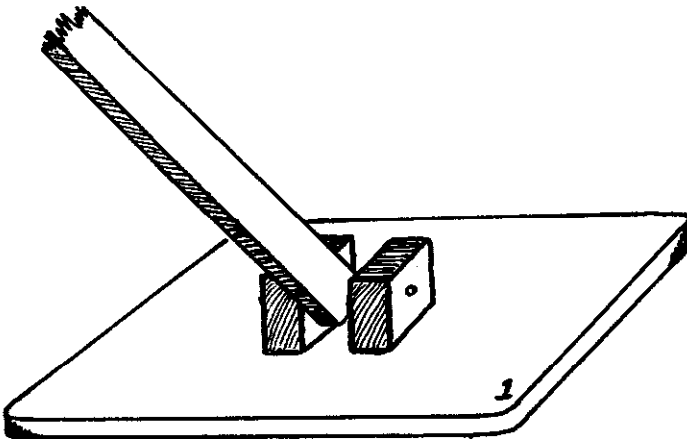
MAKE THE HOLE BIG ENOUGH
FOR ONE OF THE METAL RODS.

18



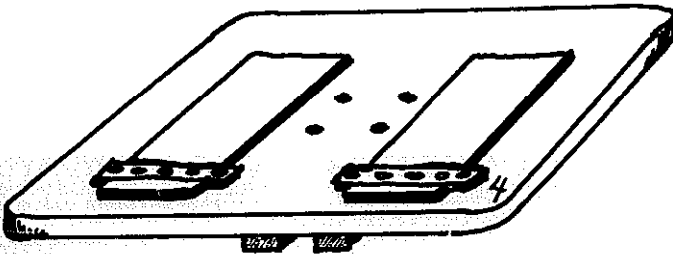
NAIL 2 OF THE PIECES
TO BOARD NUMBER 1.

PUT THEM IN THE MIDDLE
OF THE BOARD.



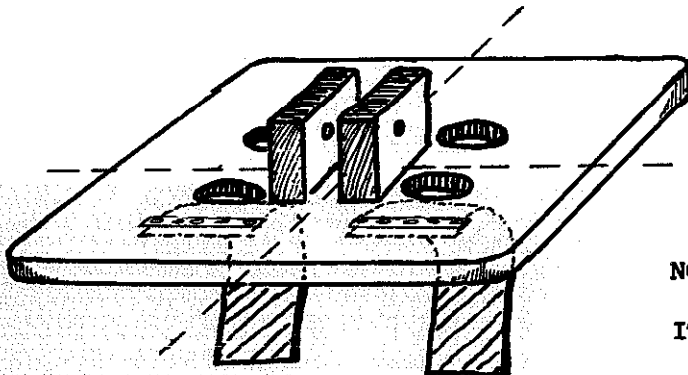
PUT THEM FAR ENOUGH APART
THAT A PIECE OF
THE 5 cm. x 2 cm. WOOD
WILL FIT LOOSELY BETWEEN THEM.

19



NAIL THE OTHER 2 PIECES TO BOARD
NUMBER 4 IN THE SAME WAY.

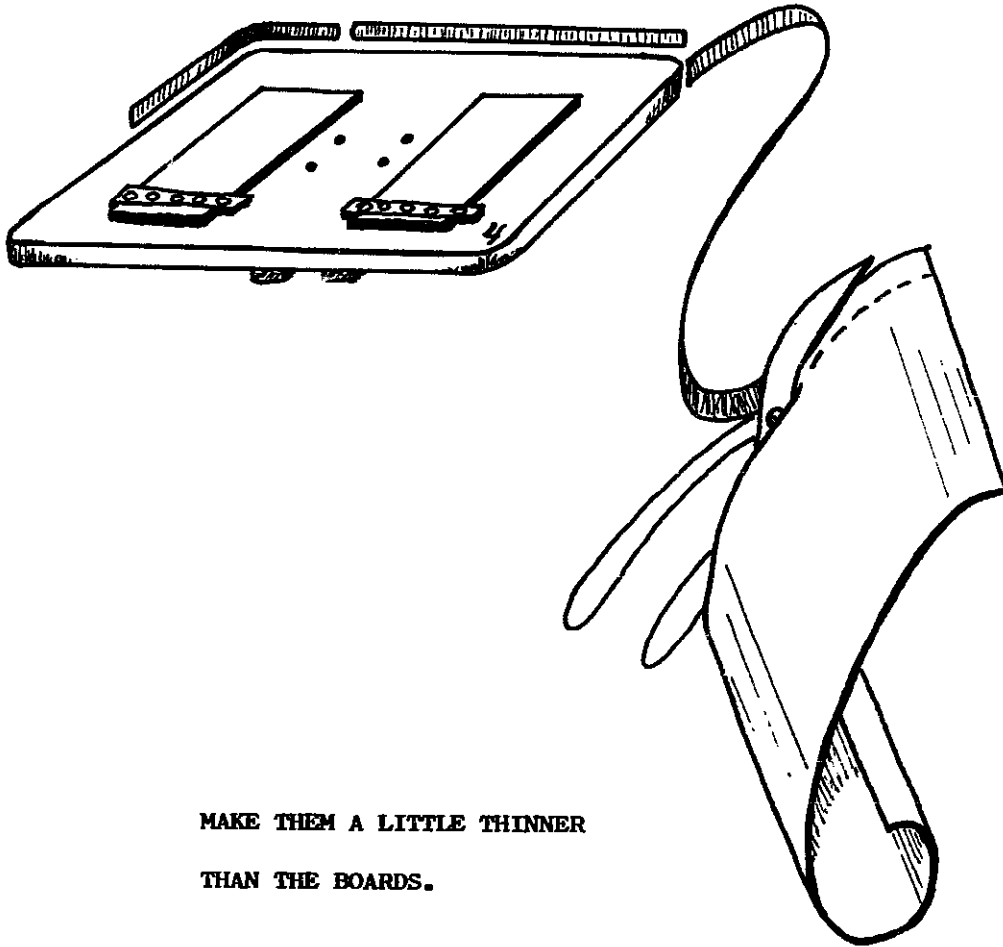
PUT THEM IN THE MIDDLE
OF THE BOARD,
ON THE SIDE WITHOUT FLAPS.



NOW IF YOU TURN OVER BOARD NUMBER 4
IT WILL LOOK LIKE THIS.

20

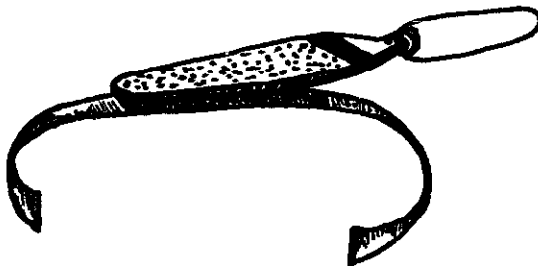
CUT THIN STRIPS OF SHEET METAL.



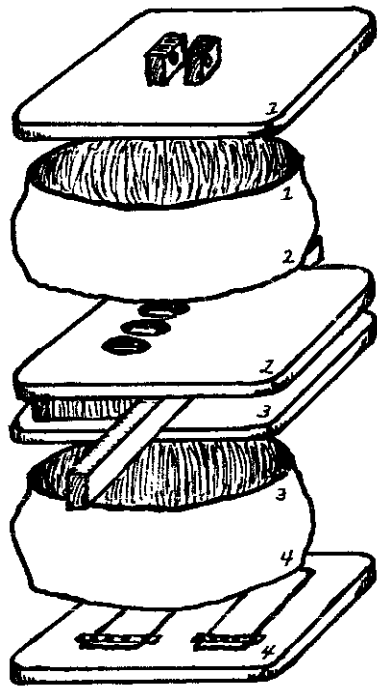
MAKE THEM A LITTLE THINNER
THAN THE BOARDS.

CUT ENOUGH PIECES TO GO
ALL AROUND THE BOARDS.

21

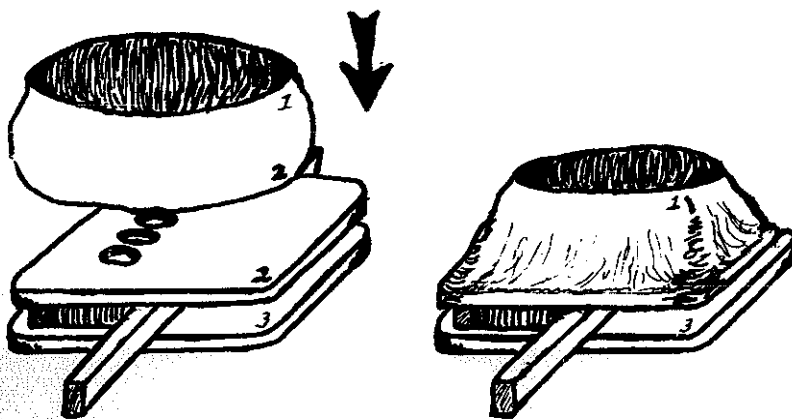


FILE OFF THE SHARP EDGES.



THE PIECES YOU HAVE MADE
WILL GO TOGETHER LIKE THIS.

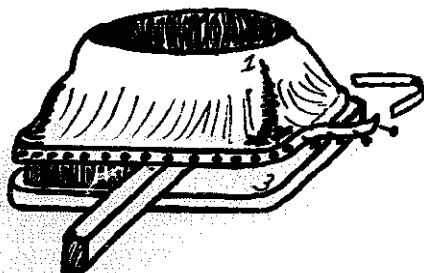
22



PUT TUBE OPENING NUMBER 2
OVER BOARD NUMBER 2.

23

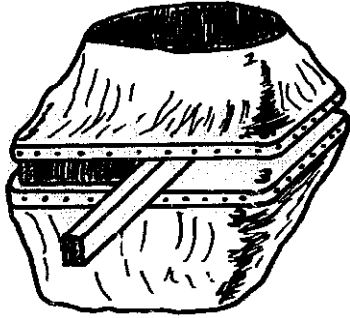
USE SHORT NAILS TO NAIL STRIPS OF SHEET METAL
AND THE TUBE TO THE BOARD.



PUT THE NAILS CLOSE TOGETHER --
3 cm. (1 in.) APART.

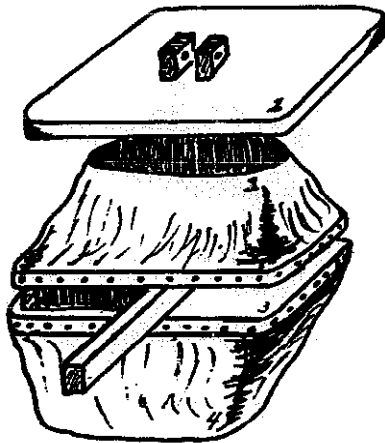
THE STRIPS OF METAL MUST NOT
GO OVER THE EDGES OF THE BOARD
AND CUT INTO THE TUBE.

24

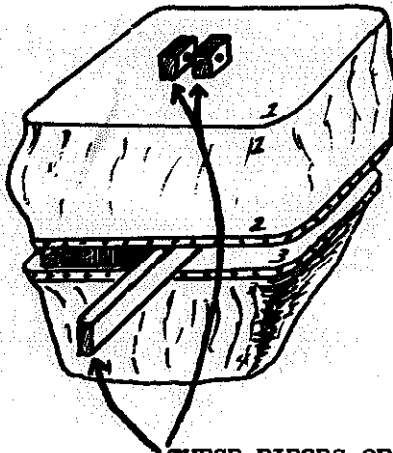


NAIL OPENING NUMBER 3 TO BOARD NUMBER 3
IN THE SAME WAY.

25



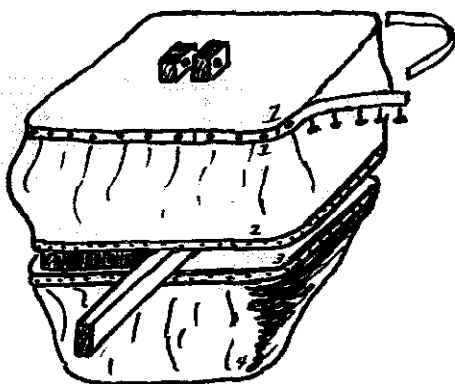
FIT BOARD NUMBER 1
INTO OPENING NUMBER 1.



THE SIDES OF BOARD NUMBER 1
MUST BE PARALLEL TO THE SIDES OF
BOARDS NUMBER 2 AND 3.

THESE PIECES OF WOOD
POINT IN THE SAME DIRECTION.

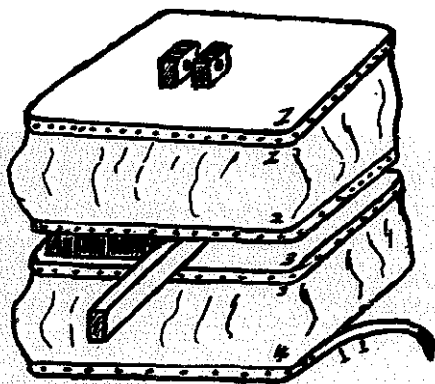
26



AGAIN USE STRIPS OF METAL
TO NAIL THE TUBE TO THE BOARD.

27

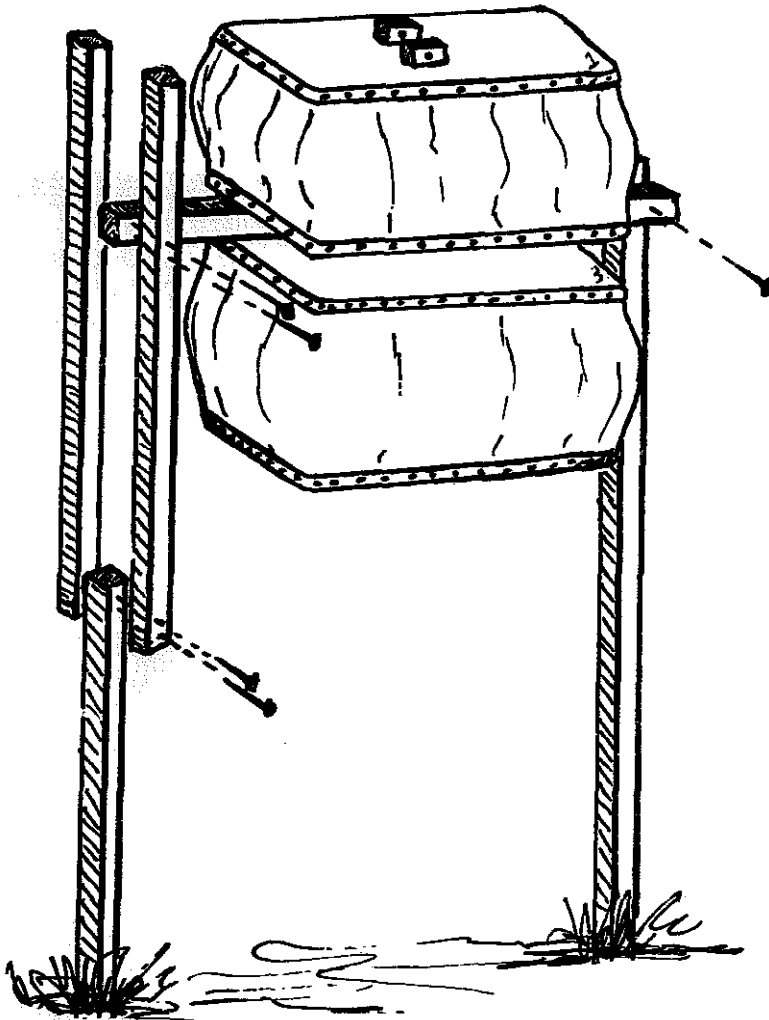
NAIL OPENING NUMBER 4 TO BOARD NUMBER 4
IN THE SAME WAY.



THE SIDES OF BOARD NUMBER 4
MUST ALSO BE PARALLEL TO THE
SIDES OF BOARDS NUMBER 2 AND 3.

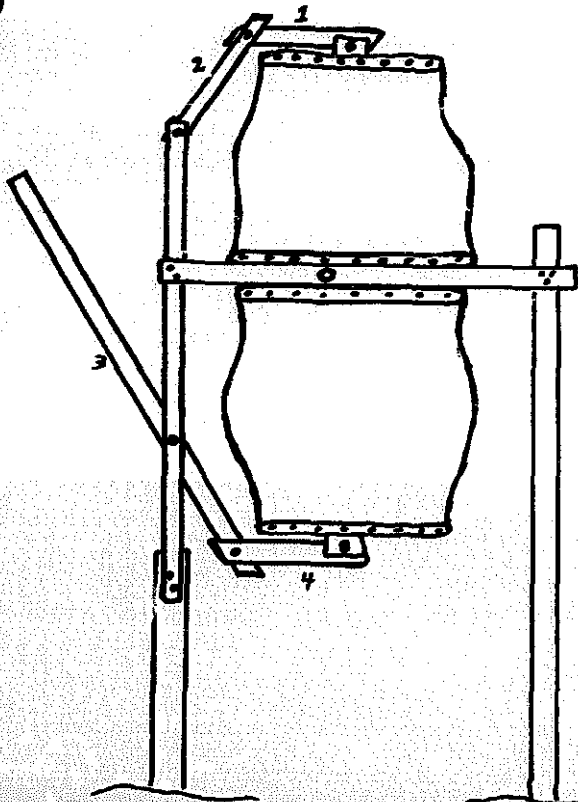
BE SURE THE FLAPS ARE INSIDE THE TUBE.

28



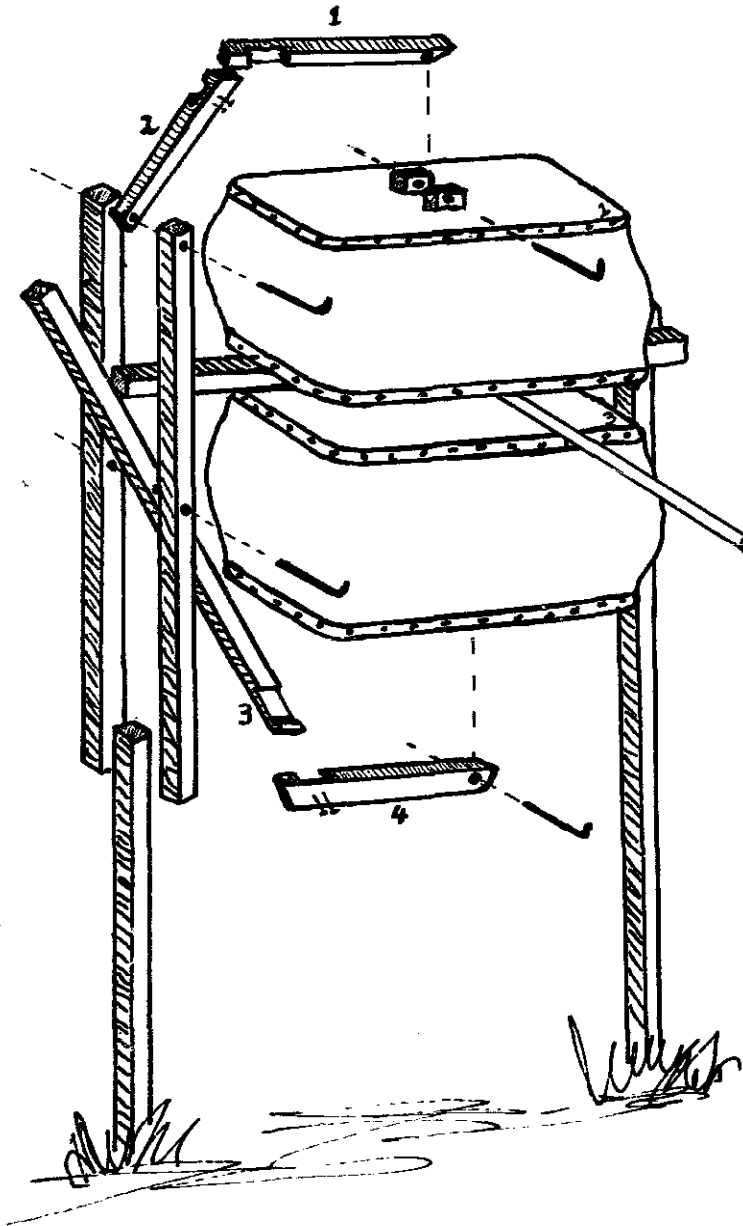
FROM THE REST OF
THE 5 cm. x 2 cm. WOOD
CUT PIECES
TO MAKE SUPPORTS.

29



CUT 4 MORE PIECES OF WOOD
TO MAKE ARMS.
MAKE THEM LONG ENOUGH SO THEY FIT
ONTO THE BELLOWS AS SHOWN.

DRILL HOLES IN THE SUPPORTS
AND ARMS WHERE SHOWN.



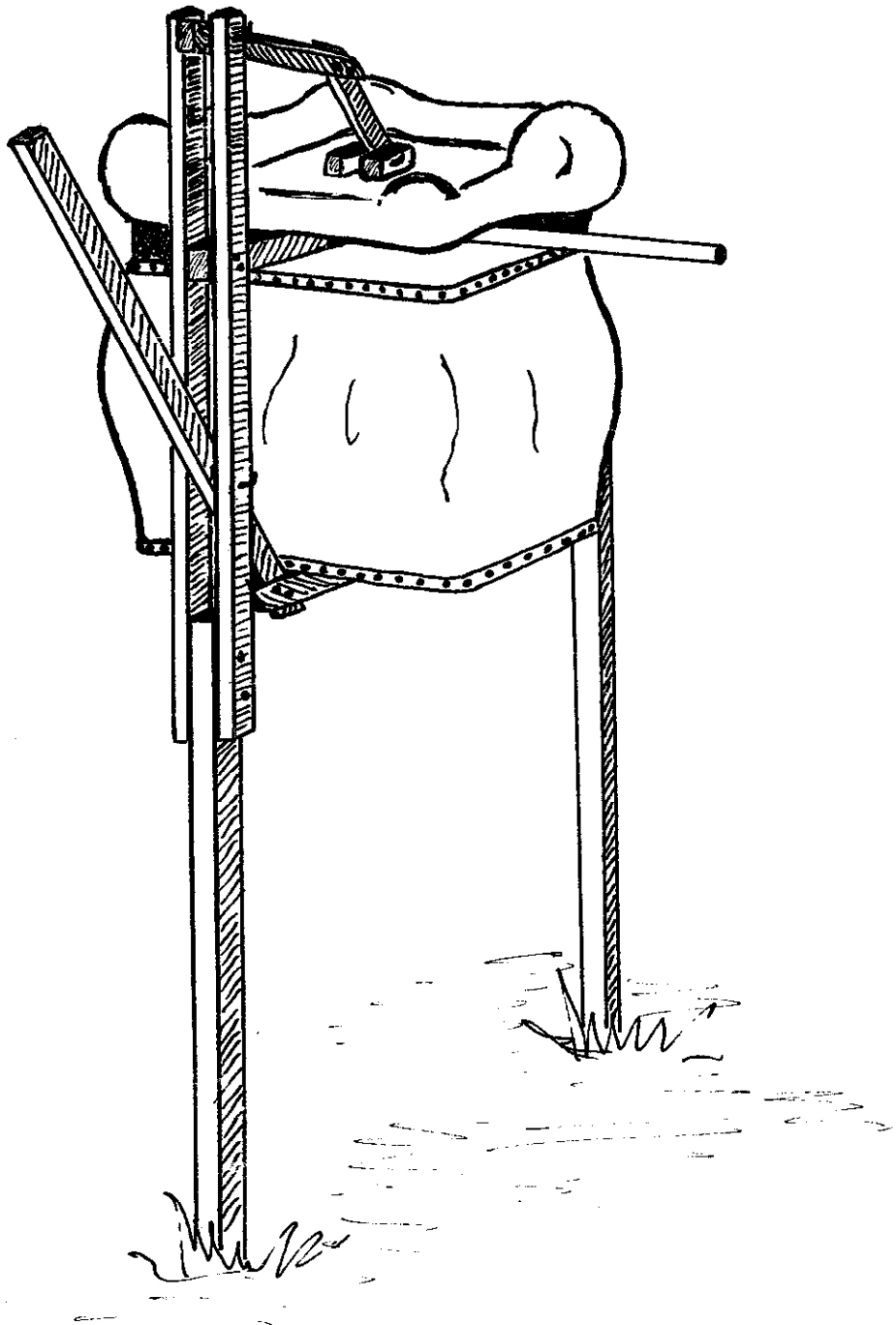
NAIL TOGETHER ARMS 1 AND 2.

NAIL TOGETHER ARMS 3 AND 4.

PUT THE ARMS IN PLACE
AND PUT THE METAL RODS
THROUGH THE DRILLED HOLES.

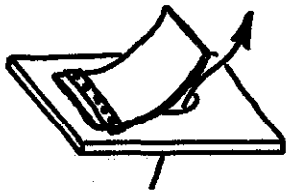
MAKE SURE THE ARMS MOVE FREELY.

FIT THE PIPE INTO THE HOLE
MADE IN STEP NUMBER 12.

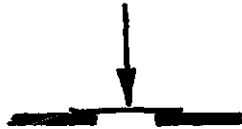
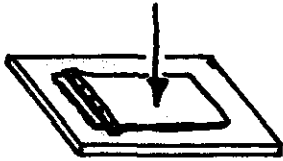


THE FINISHED BELLOWS LOOK LIKE THIS.

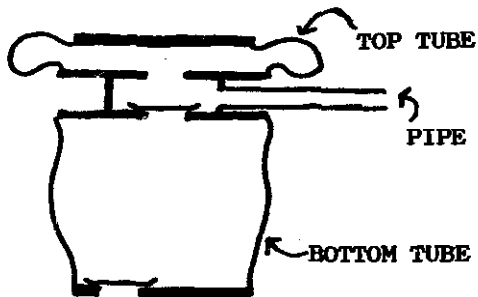
HOW IT WORKS



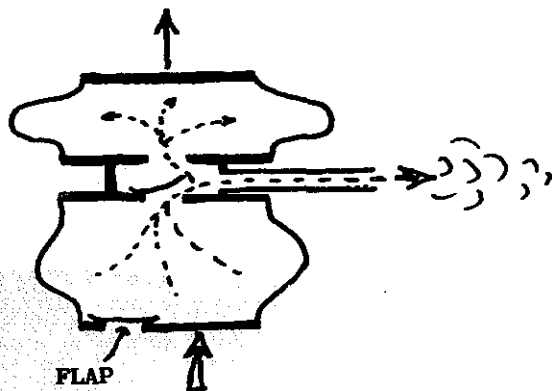
AIR MOVES THROUGH THE HOLE
IN ONE DIRECTION.



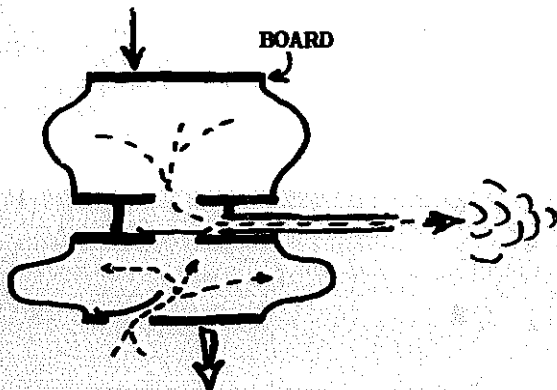
THE FLAP STOPS THE AIR
FROM MOVING BACK
IN THE OTHER DIRECTION.



WHEN YOU START TO USE THE BELLOWS,
THE TOP TUBE HAS NO AIR IN IT.
THE BOTTOM TUBE IS FULL OF AIR.



THE HANDLE PUSHES UP THE BOTTOM TUBE.
THIS FORCES AIR OUT THROUGH THE PIPE,
AND INTO THE TOP TUBE.
THE BOTTOM FLAP STOPS THE AIR
FROM GOING OUT THROUGH THE HOLE
IN THE BOTTOM BOARD.



THEN THE BOTTOM TUBE FALLS DOWN AGAIN.
THIS SUCKS AIR BACK INTO THE
BOTTOM TUBE THROUGH THE HOLE.
AT THE SAME TIME, THE AIR
IN THE TOP TUBE IS BEING FORCED OUT
THROUGH THE PIPE BY THE WEIGHT OF
THE BOARD ON TOP.

SO THERE IS ALWAYS AIR
COMING OUT THROUGH THE PIPE.