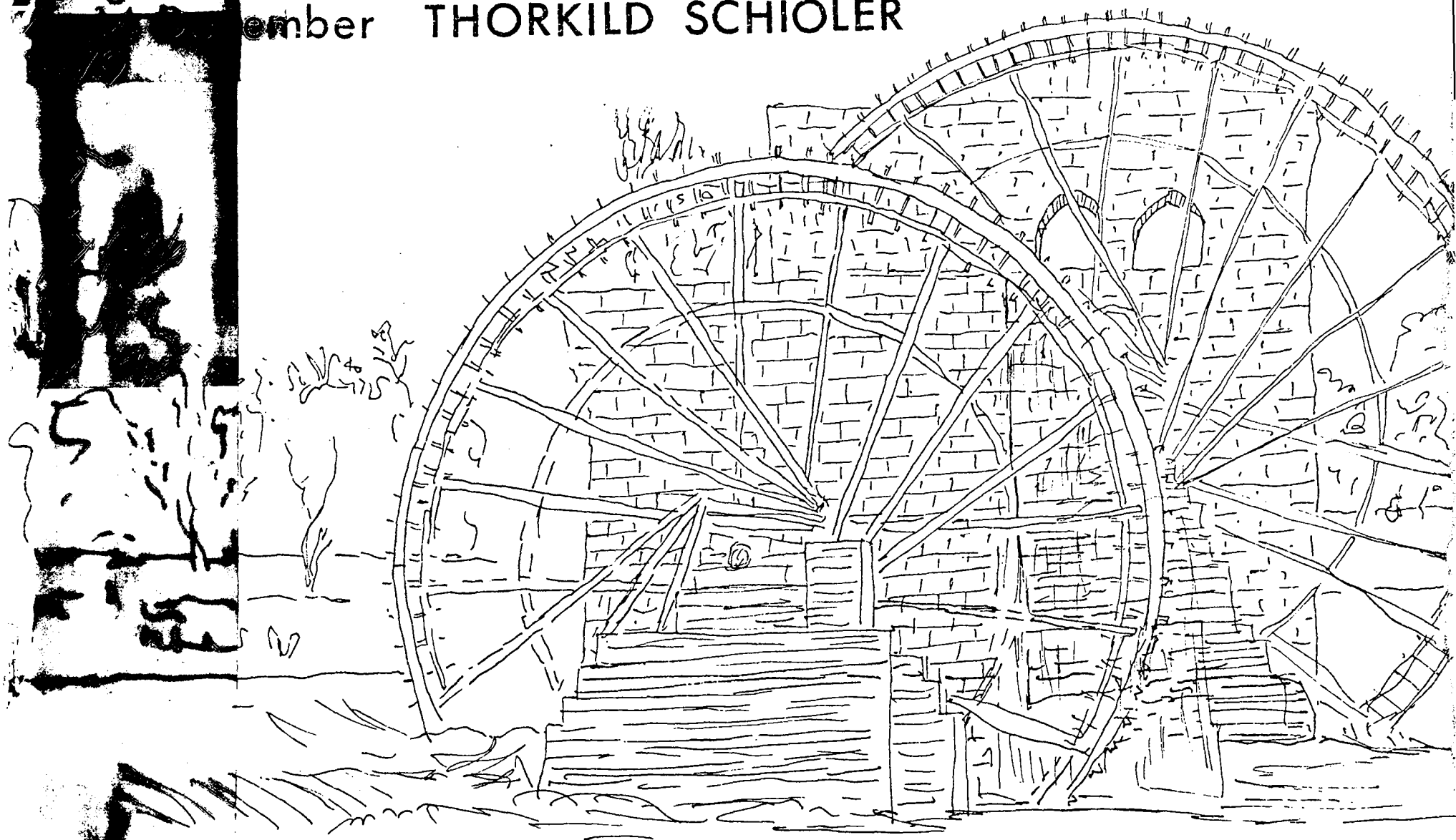
WATER-LIFTING DEVICES

ember THORKILD SCHIOLER



762
230
79WA

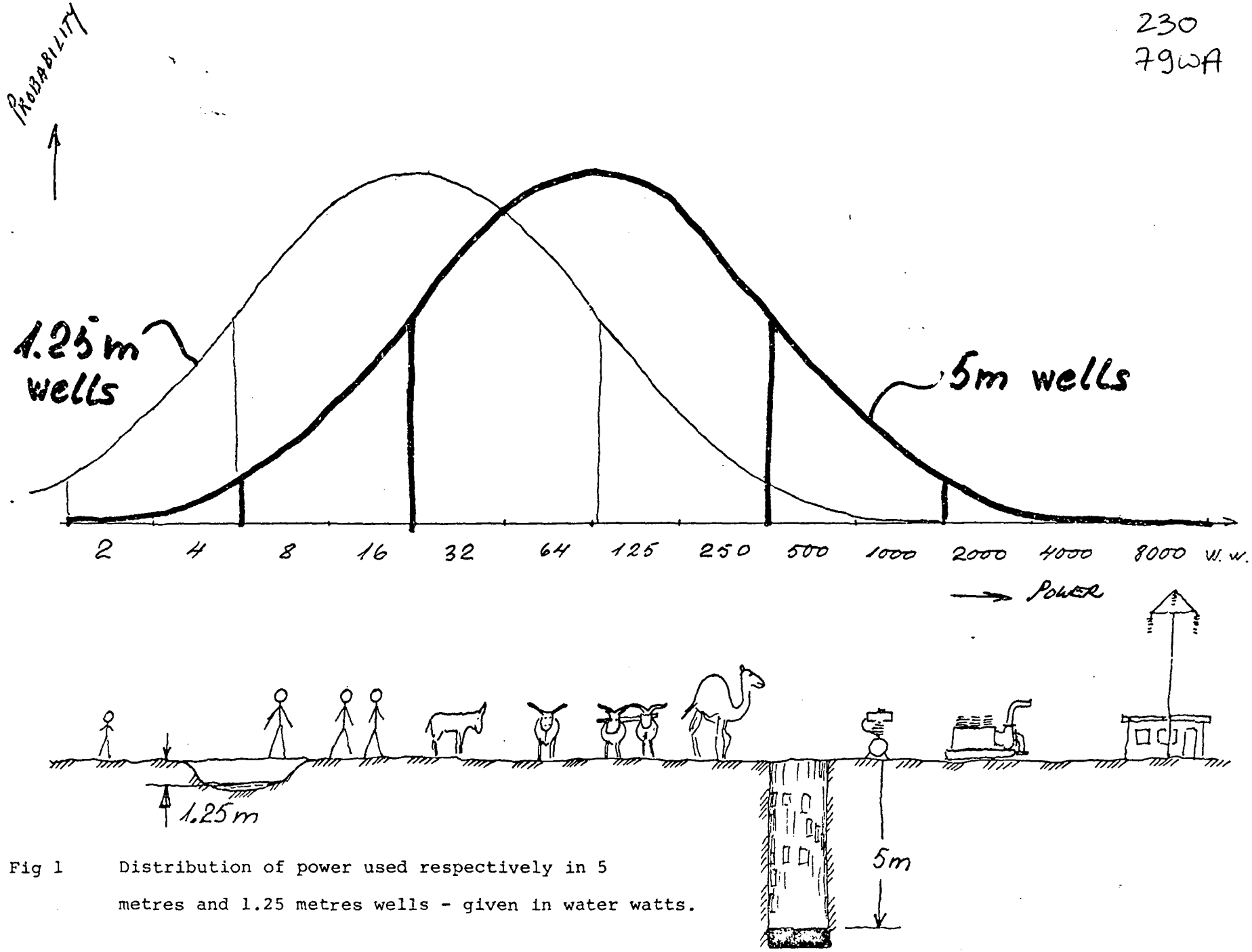


Fig 1 Distribution of power used respectively in 5 metres and 1.25 metres wells - given in water watts.

Fig 2 Carrying water for irrigation; Note that this girl is overloaded

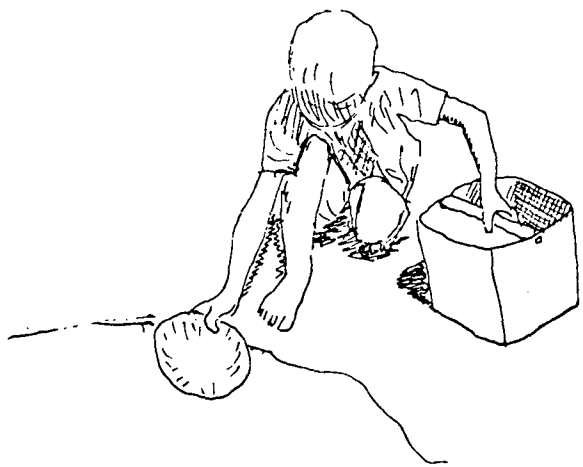


Fig 3 Boy collecting water for vegetables-irrigation. Low price device and low price worker

Fig 4 Old man spreads water taken from irrigation furrow. ("Agricultural Water Management" Vol 1 Amsterdam 1977 p. 155-164)

Fig 5a Water is transported to the paddy

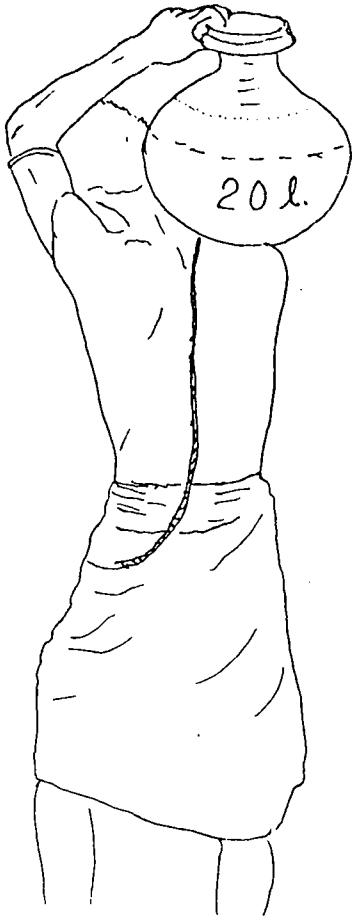
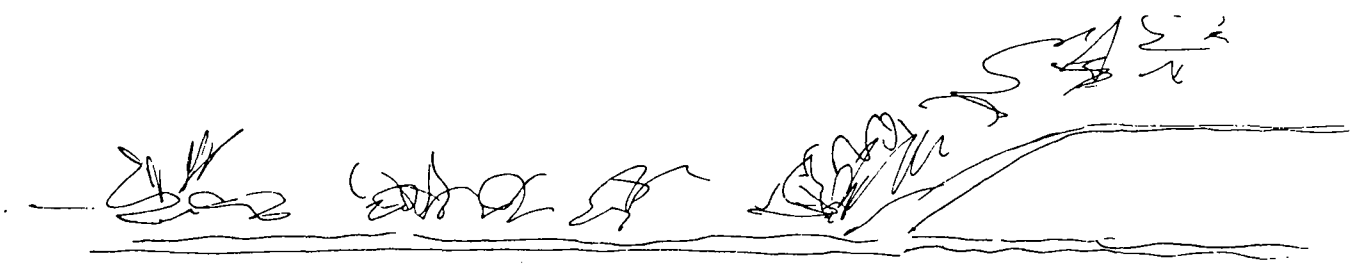


Fig 5b Water poured out on paddy



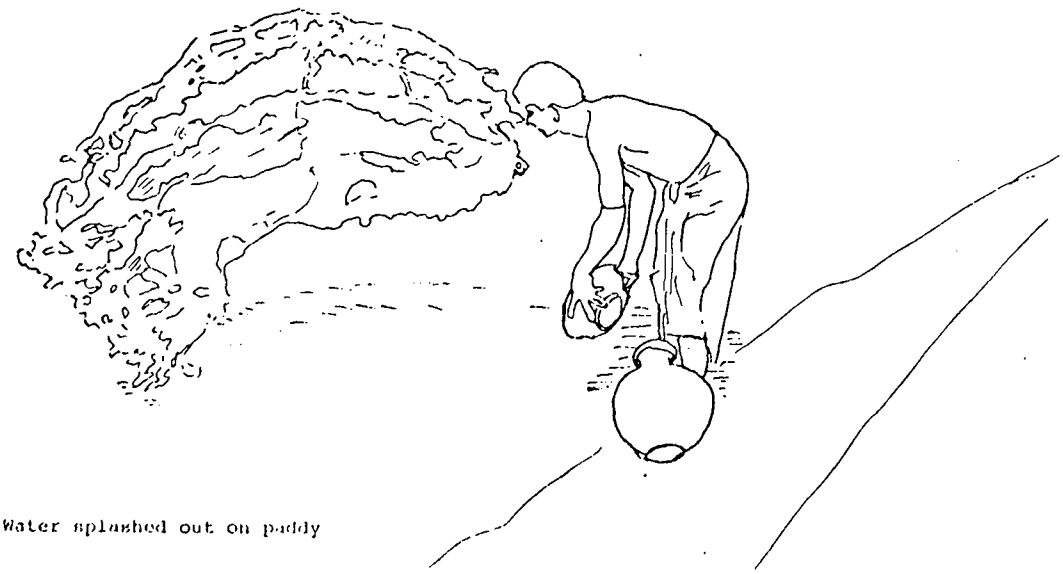


Fig 5c Water splashed out on paddy

Fig 6 Water shovel used instead of bovl

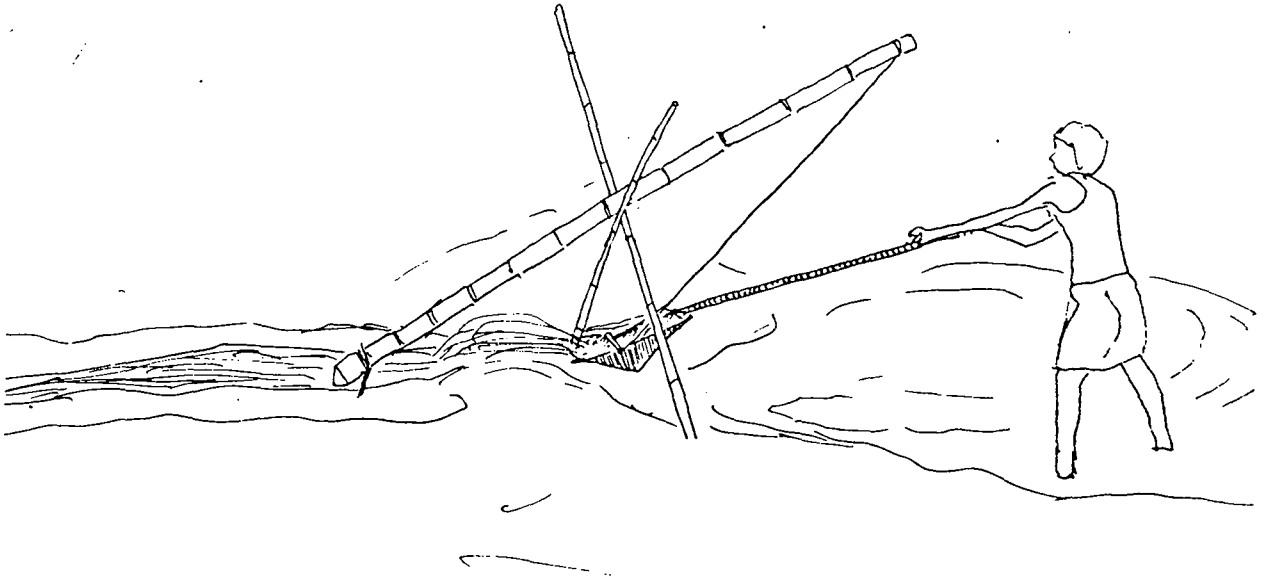
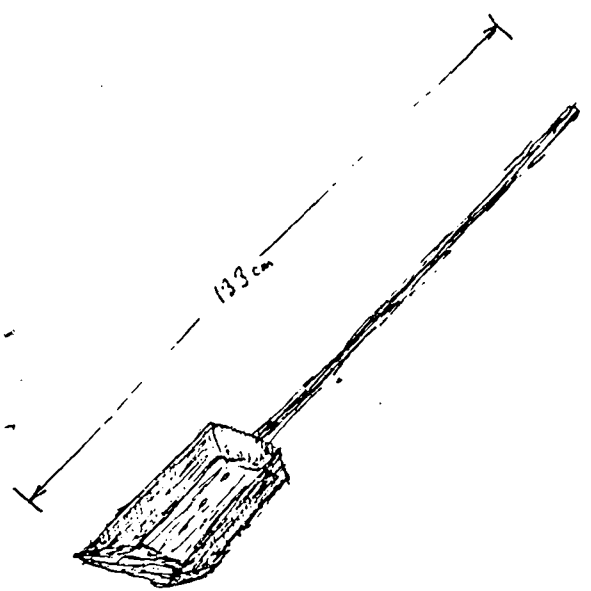
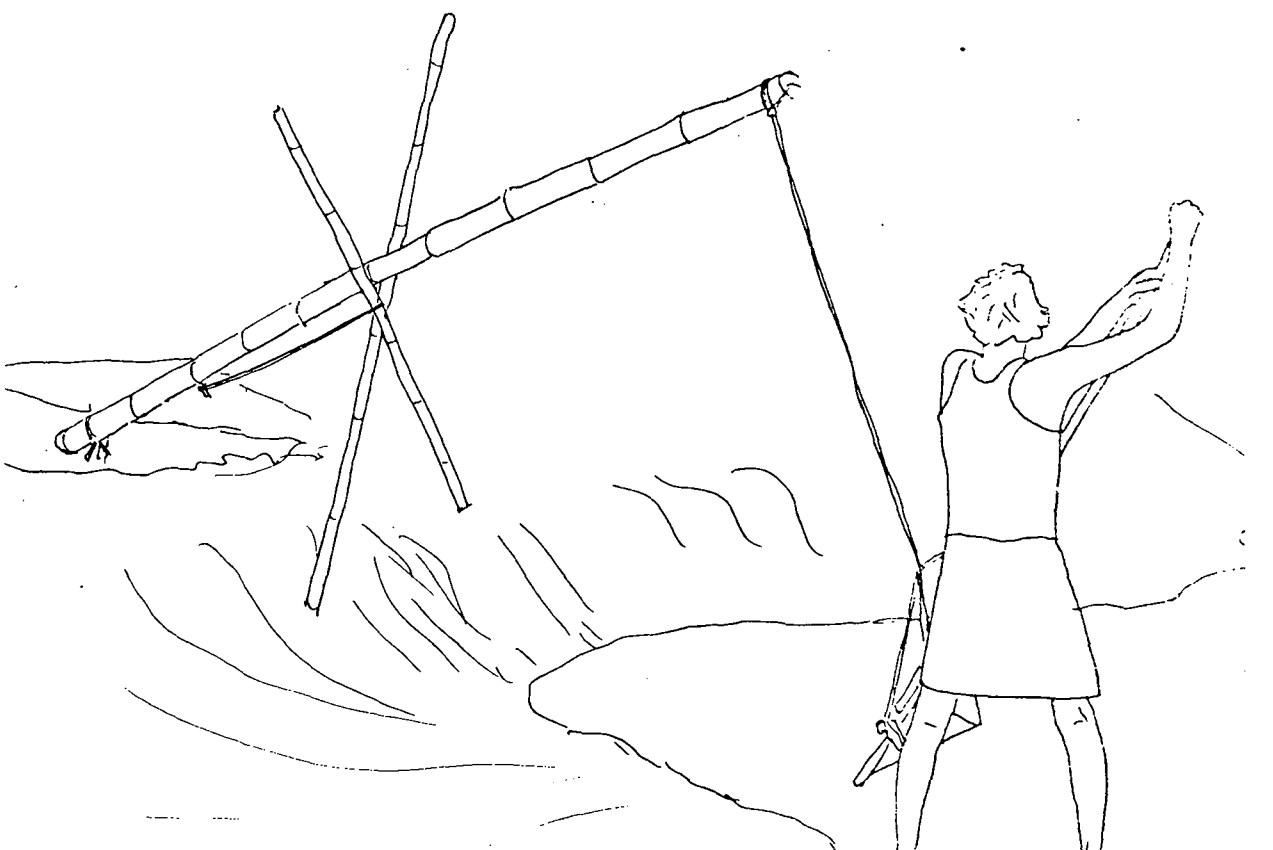


Fig 7 Two views of surspended shovel. A swing is made every two seconds





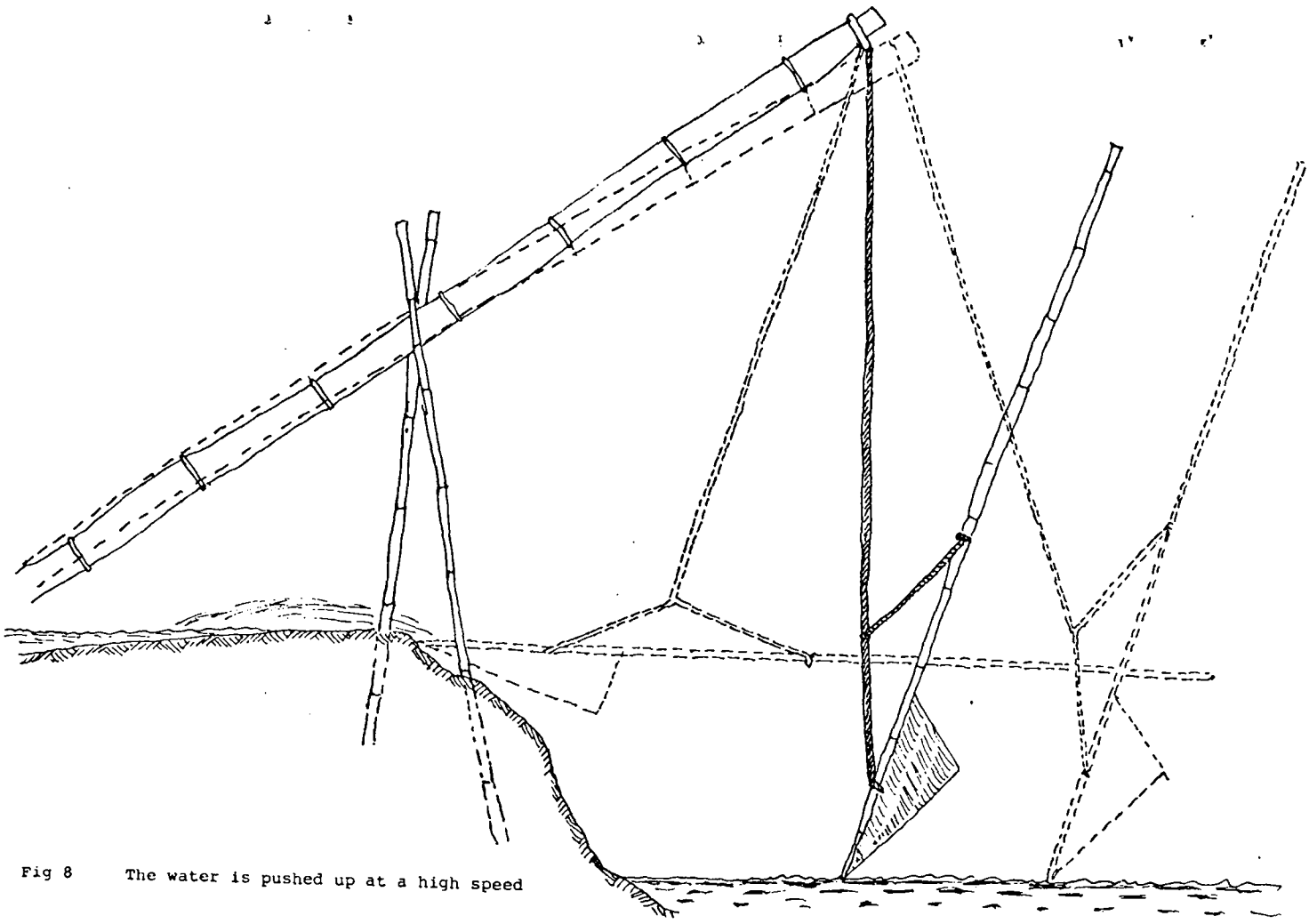


Fig 8 The water is pushed up at a high speed

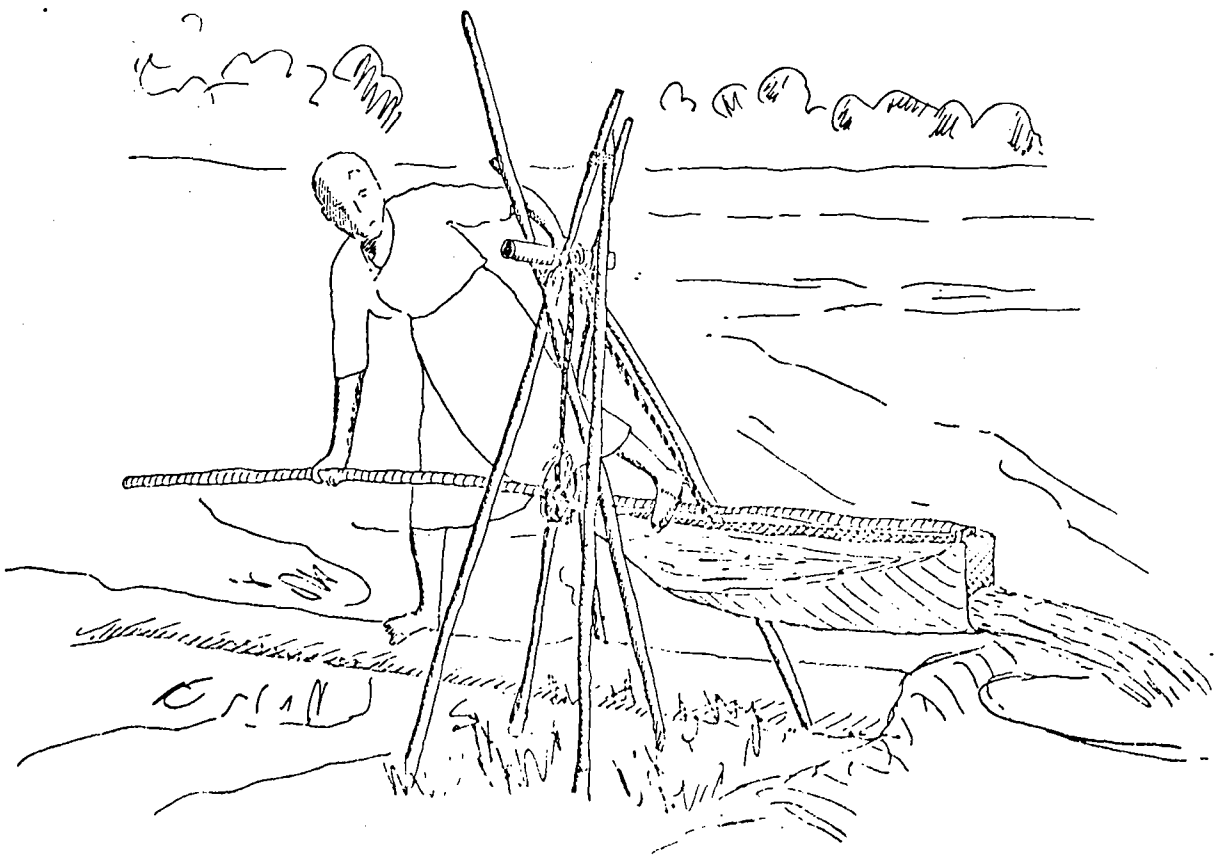


Fig 9 Suspended shovel; hand and foot operated

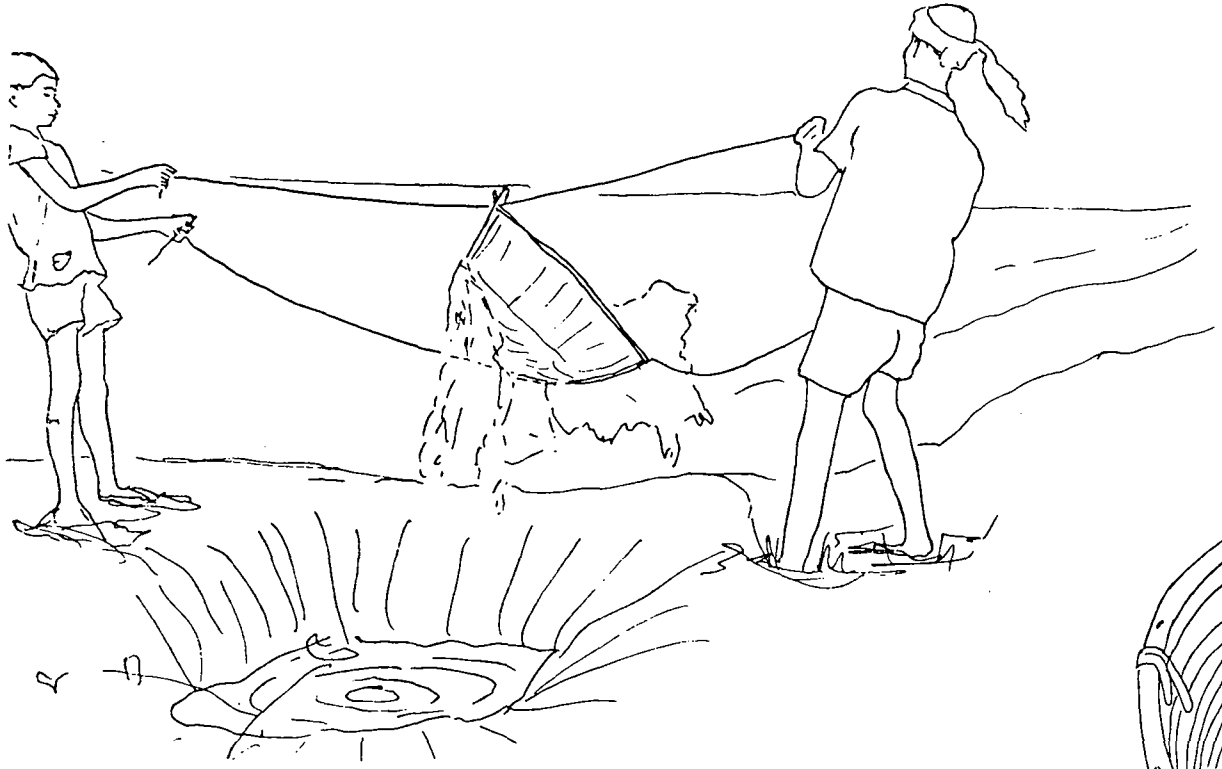


Fig 10 Handling of a swing basket. The basket is lifted one metre but the head is just 0.2 metres

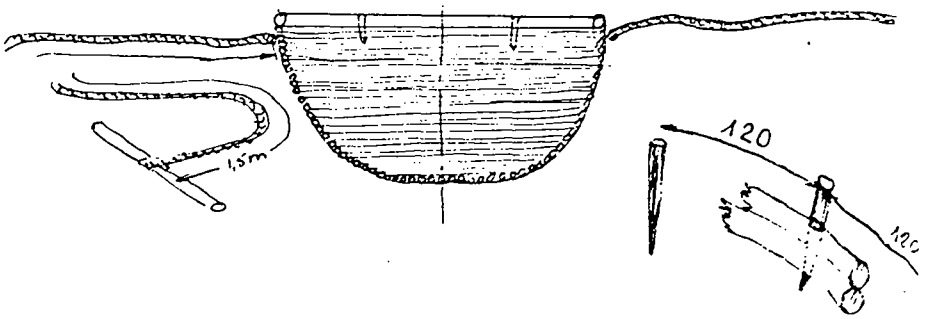
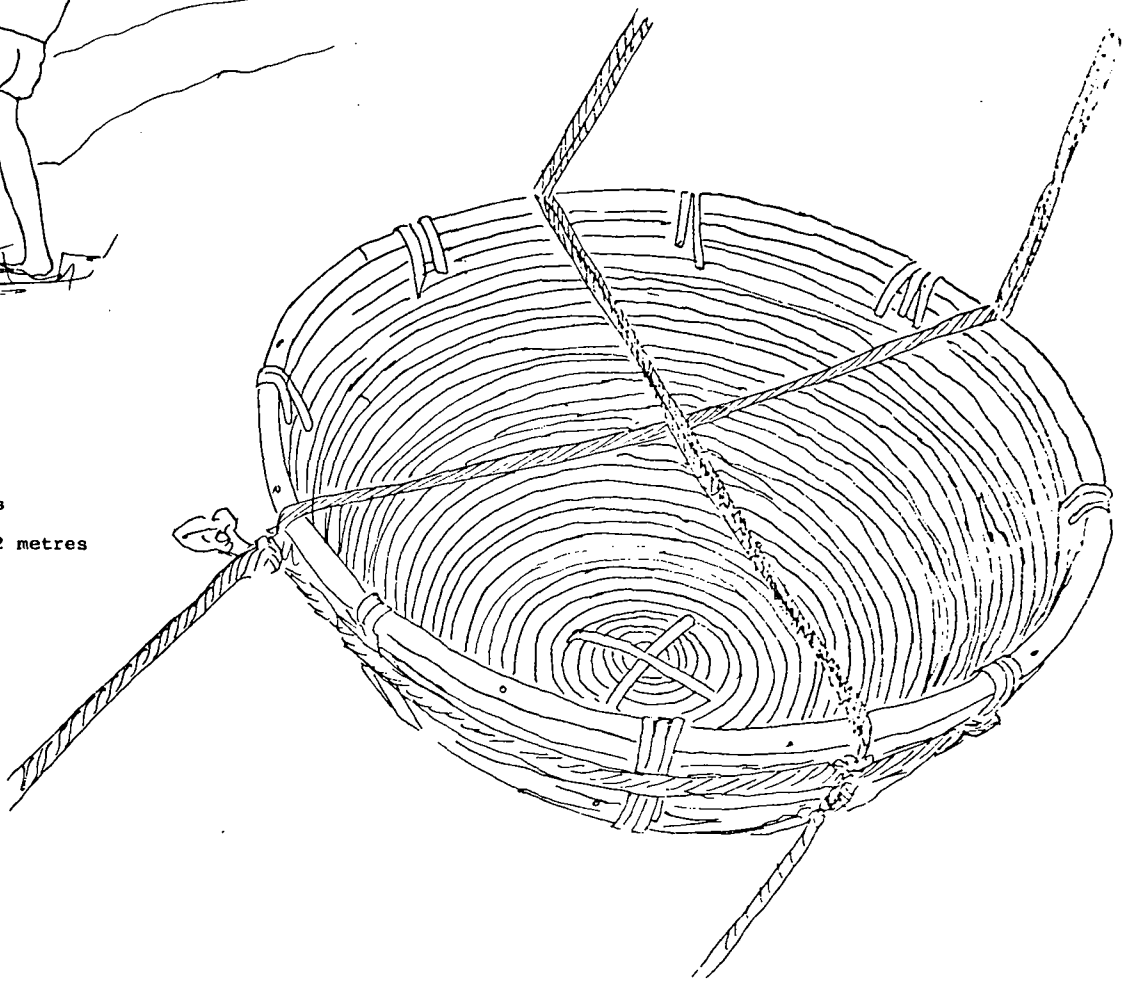


Fig 11 Swing basket in wicker work, is nailed together by 150 small bamboo pegs



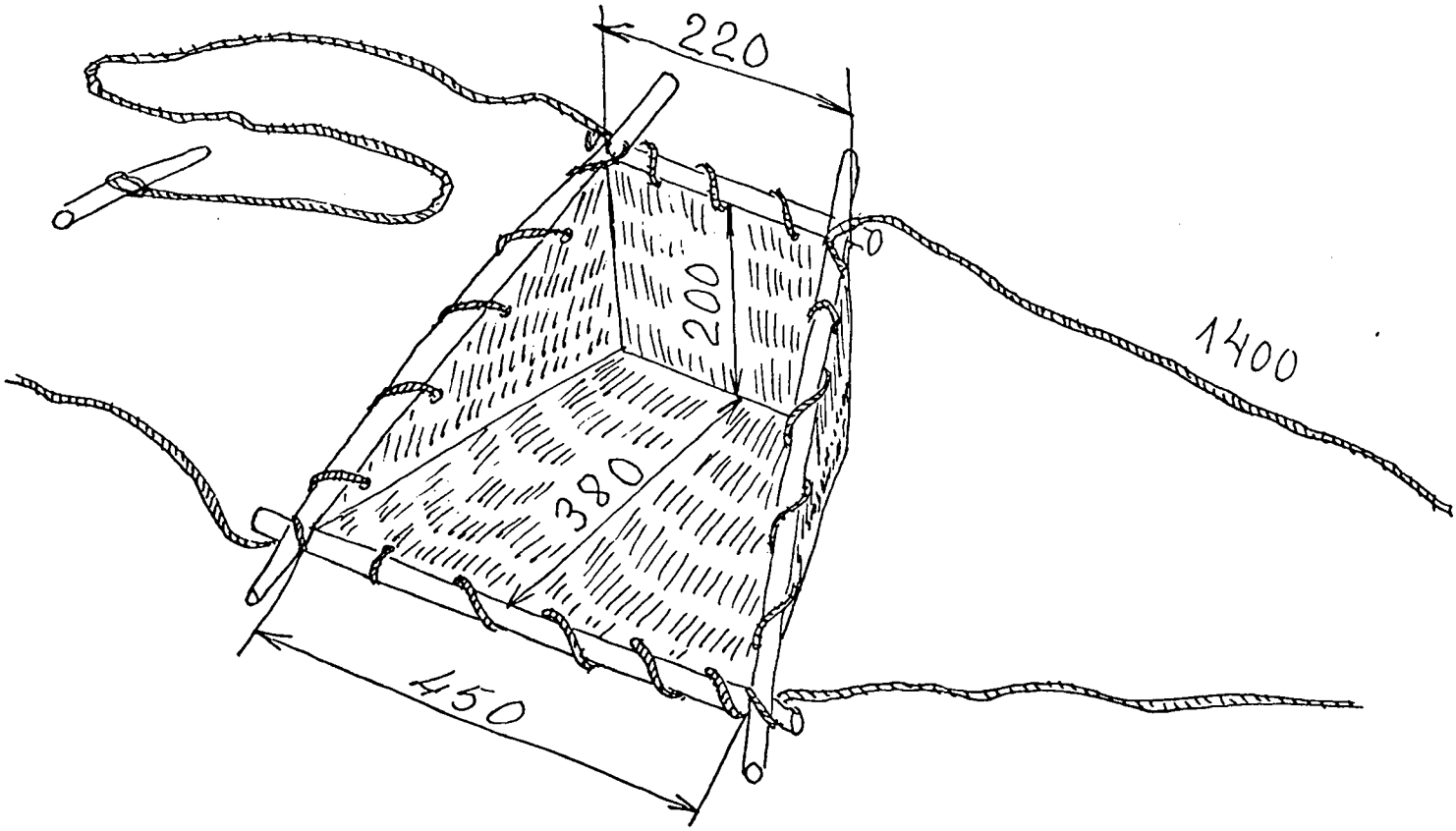


Fig 12 Swing basket made of ironsheets; made from an old petrol can

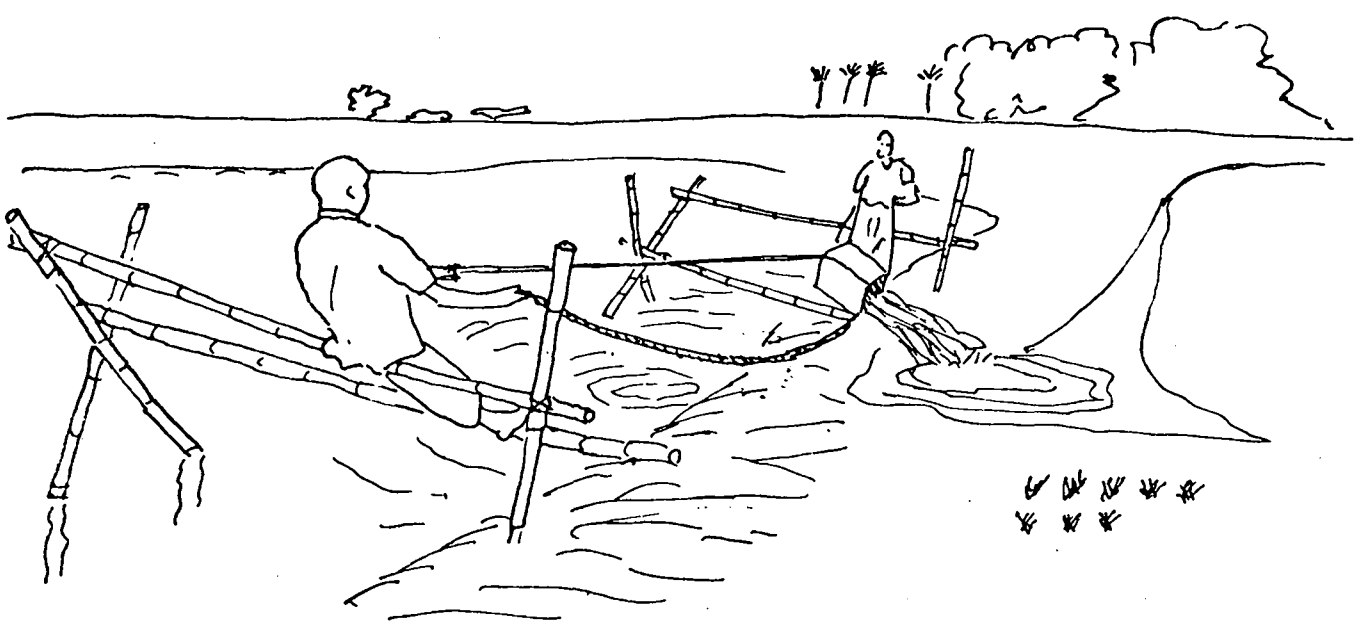


Fig 13 Swing basket - an old petrol can - worked by sitting men

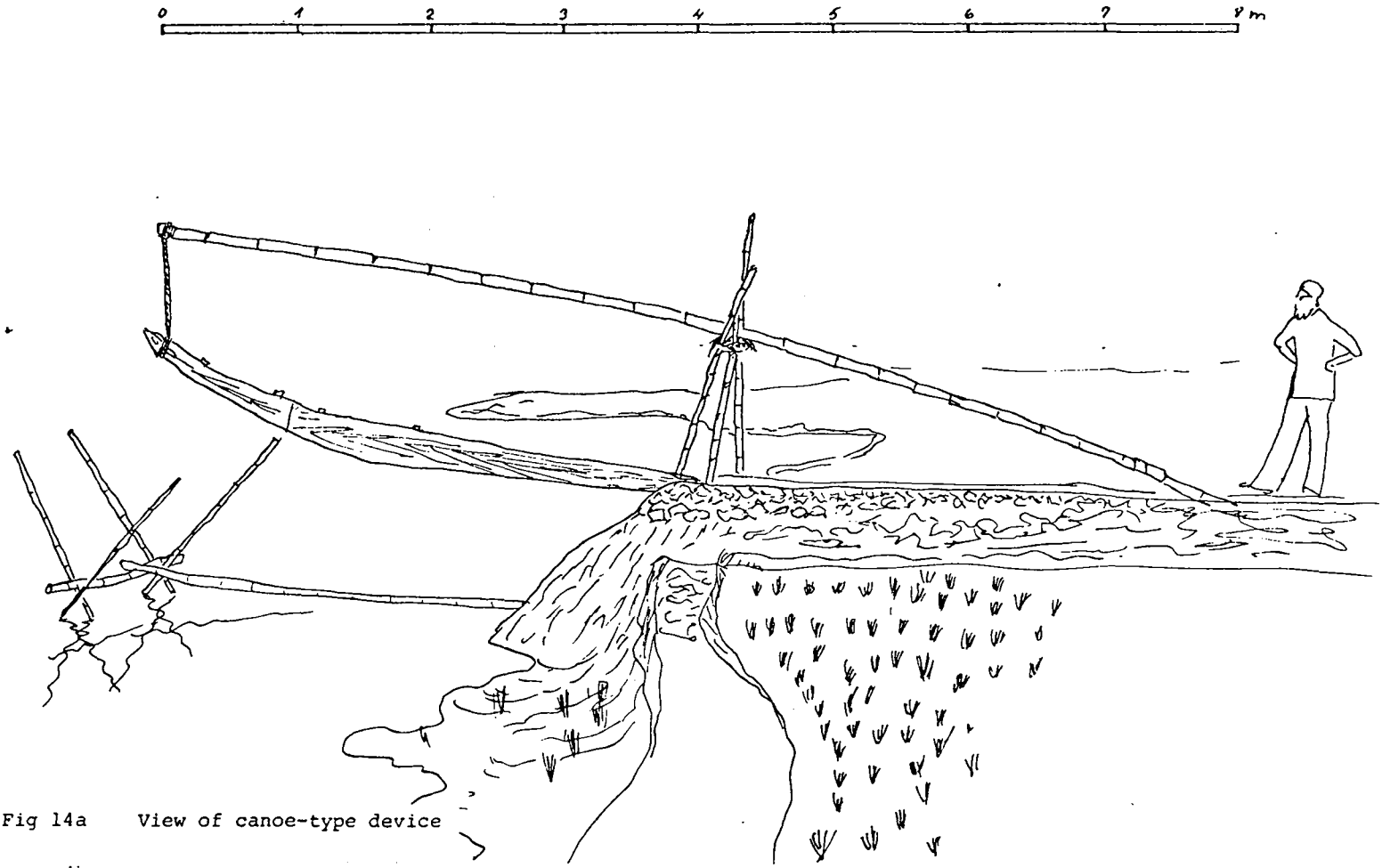


Fig 14a View of canoe-type device

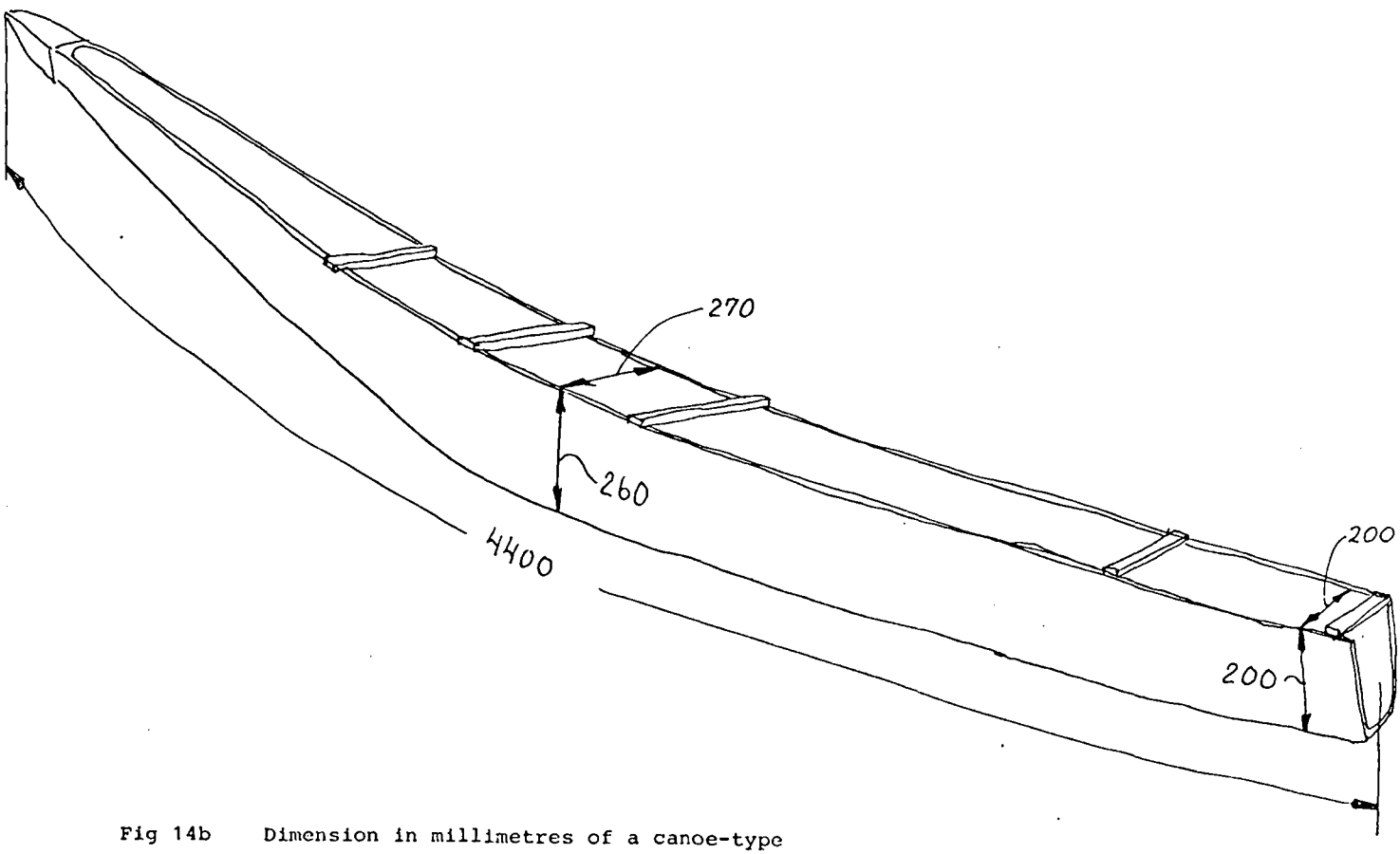


Fig 14b Dimension in millimetres of a canoe-type

Egypt

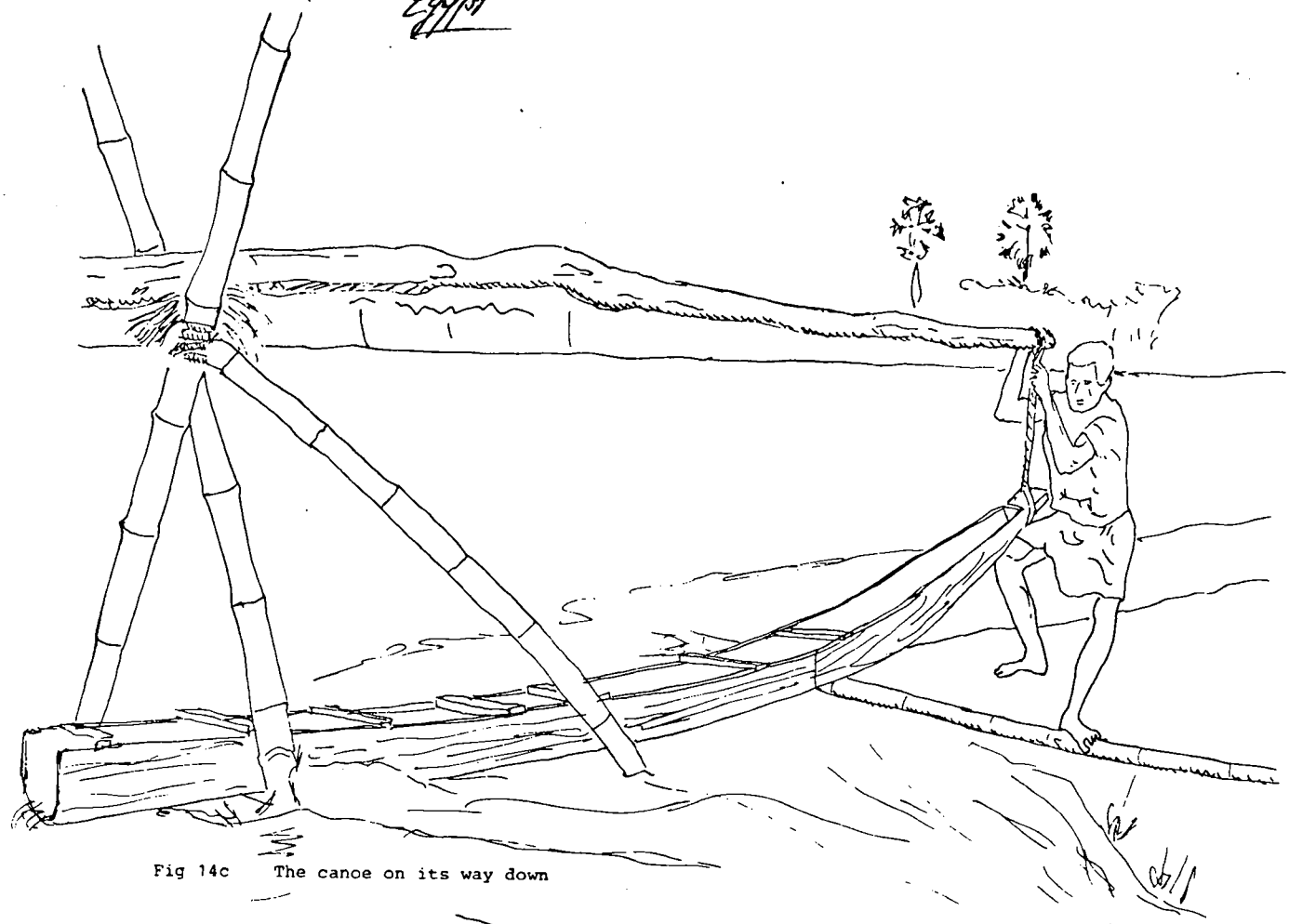


Fig 14c The canoe on its way down

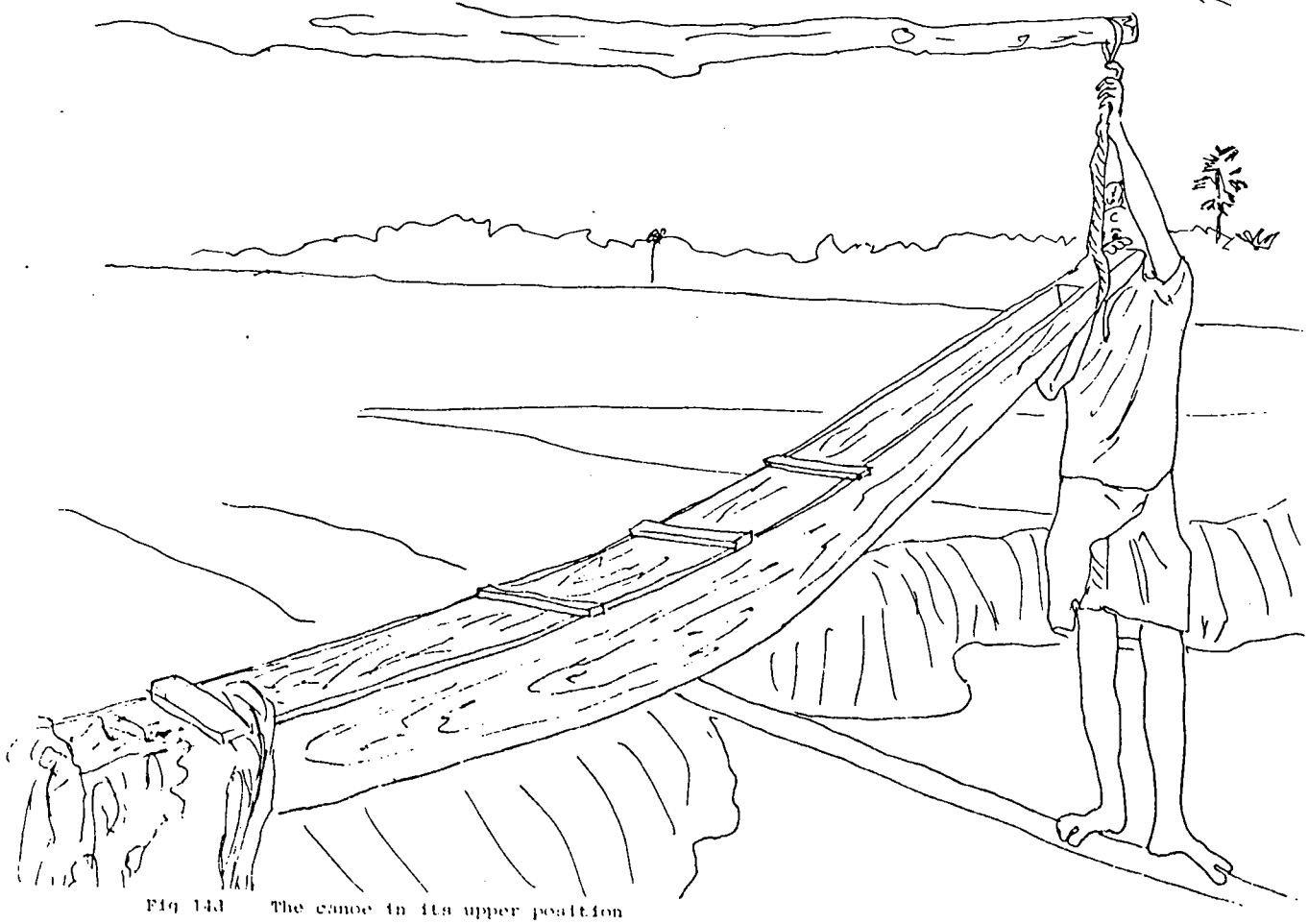


Fig 14d The canoe in its upper position

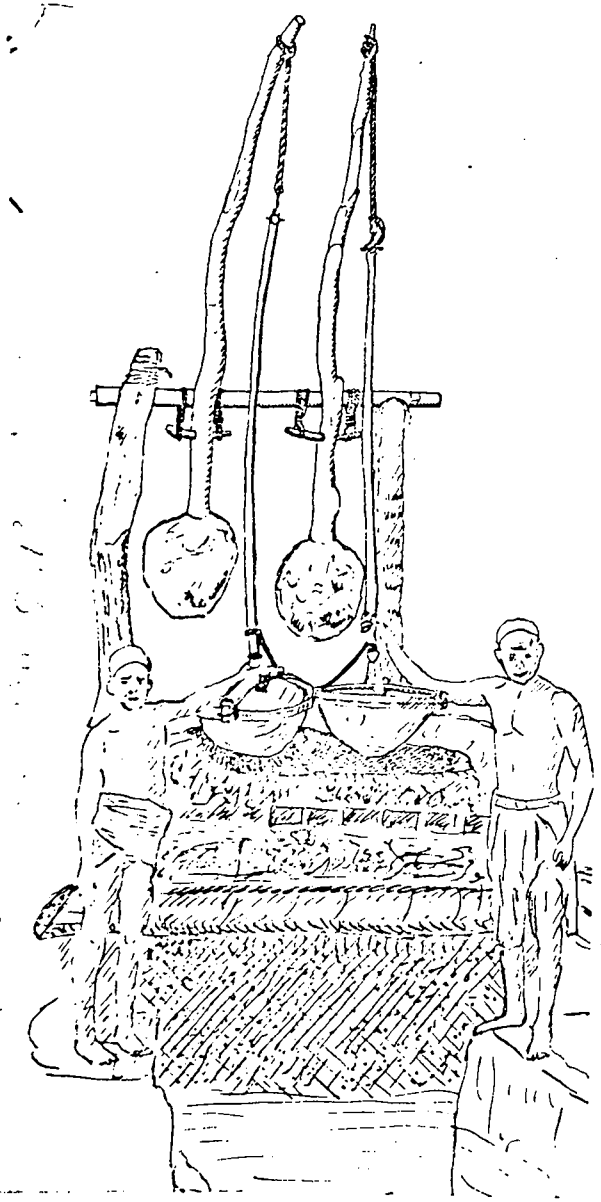


Fig 15 The Egyptian counterpoise device. A 4500 years old invention

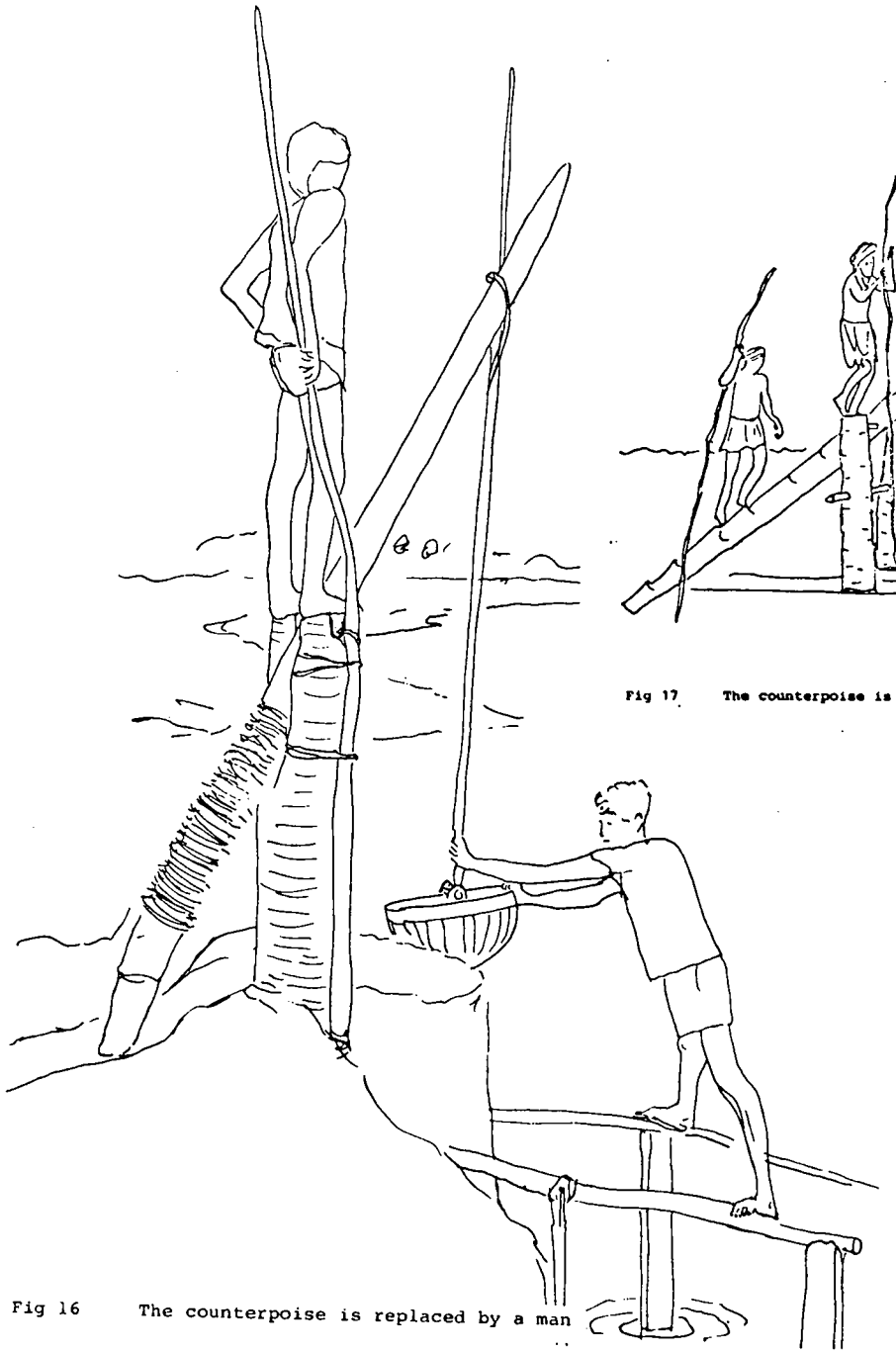


Fig 16 The counterpoise is replaced by a man

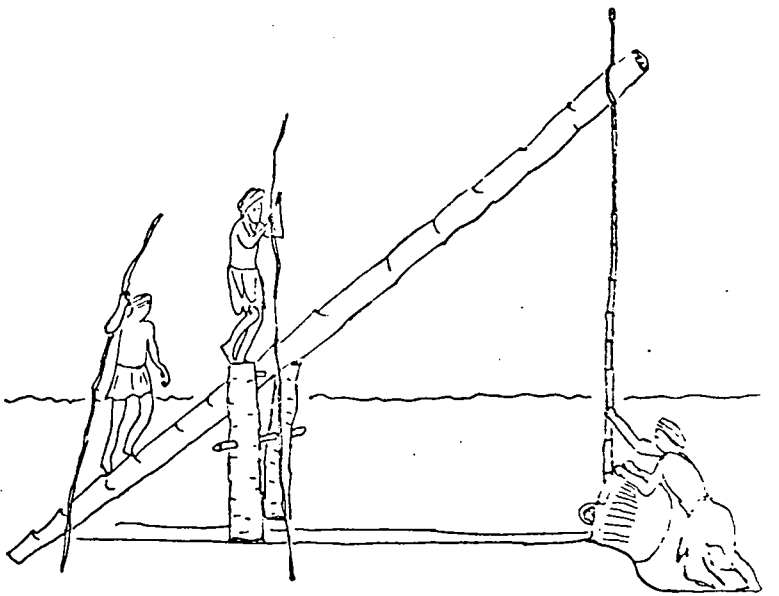


Fig 17 The counterpoise is replaced by two men

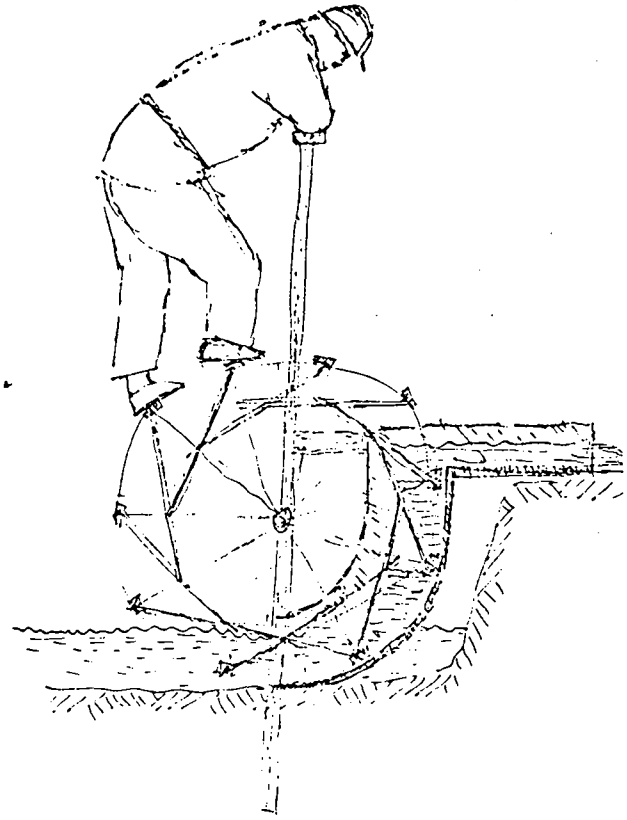
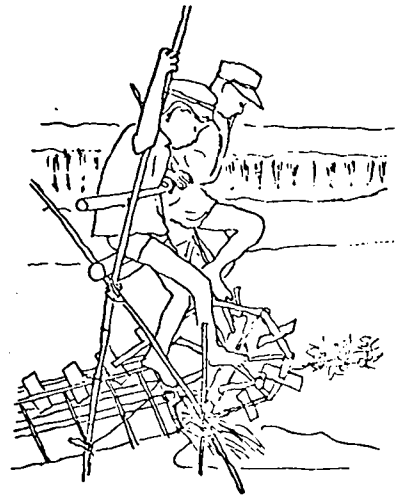


Fig 18 The paddle wheel



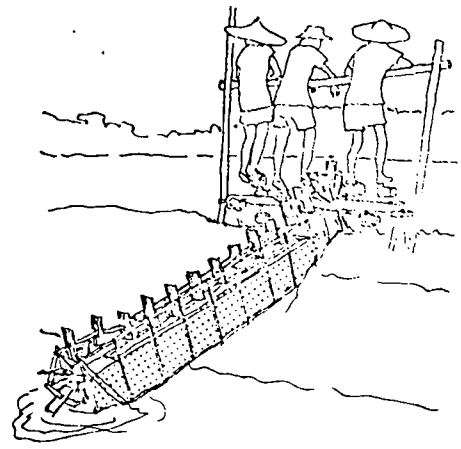


Fig 19 Two views of a water ladder in operation made intirely in wood

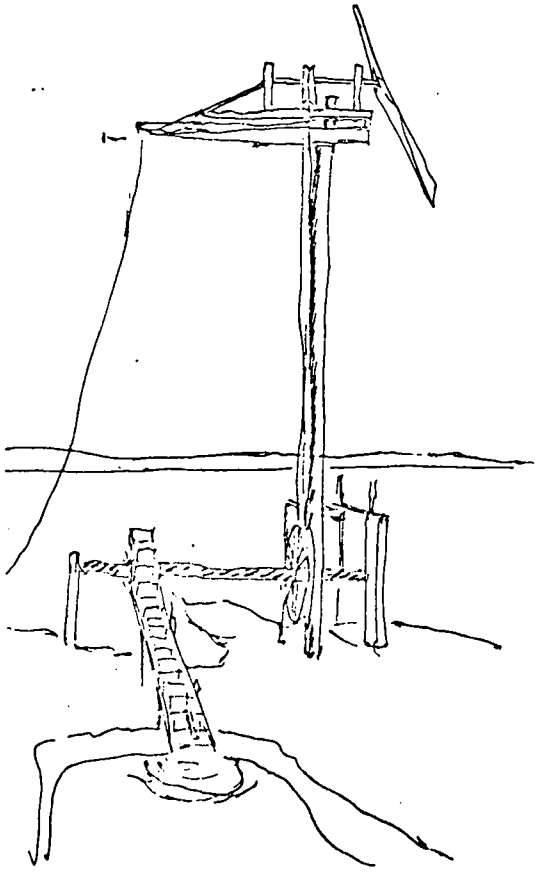


Fig 20 Water ladder powered by wind propeller

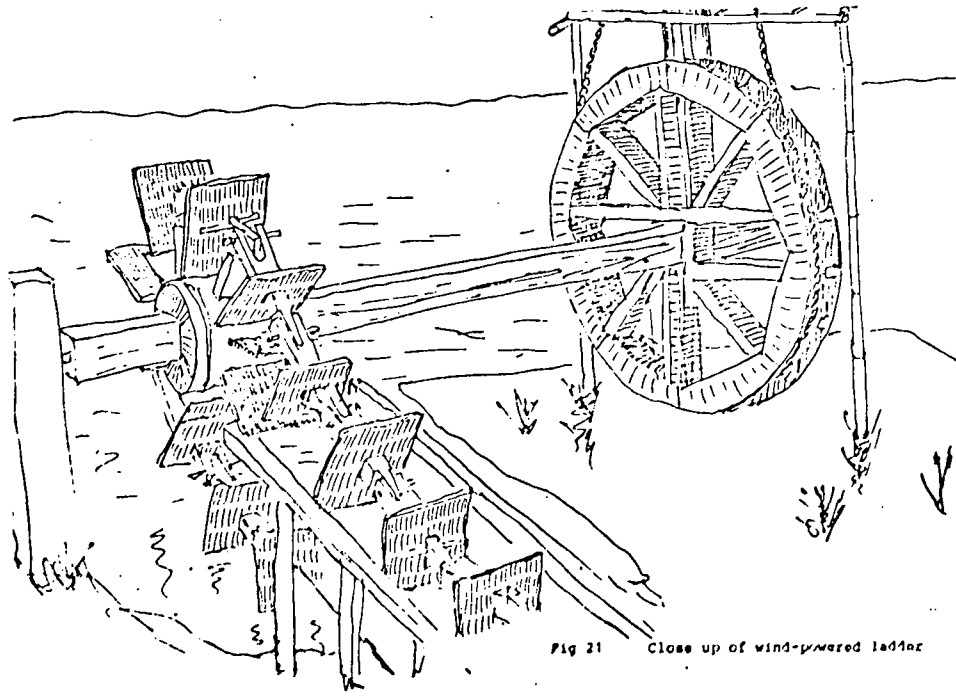
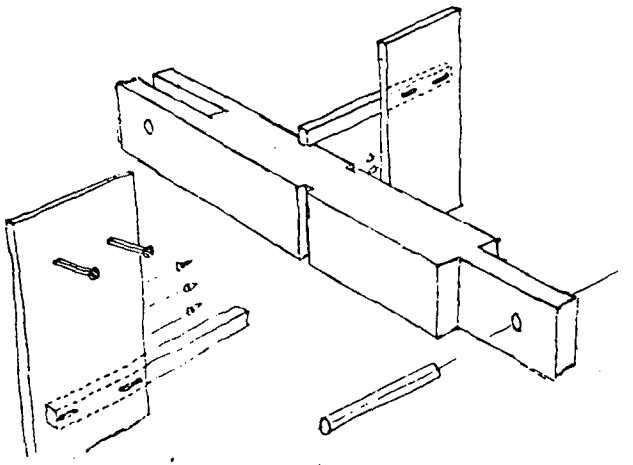


Fig 21 Close up of wind-powered ladder

Fig 22 Detail of a ladder element



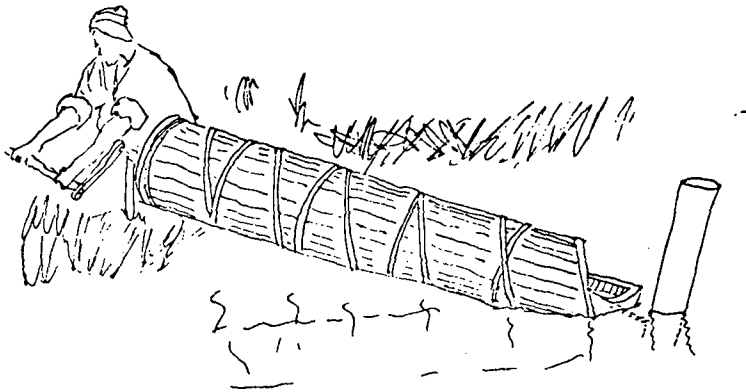
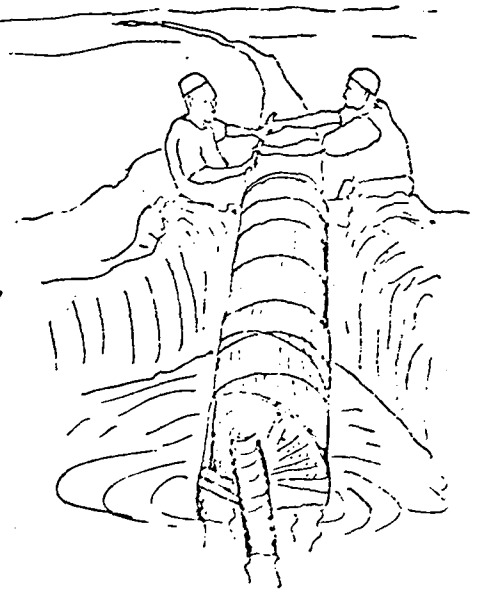


Fig 23 Two views of an Archimedean screw. Two men are needed if the water head is 0.6 metres



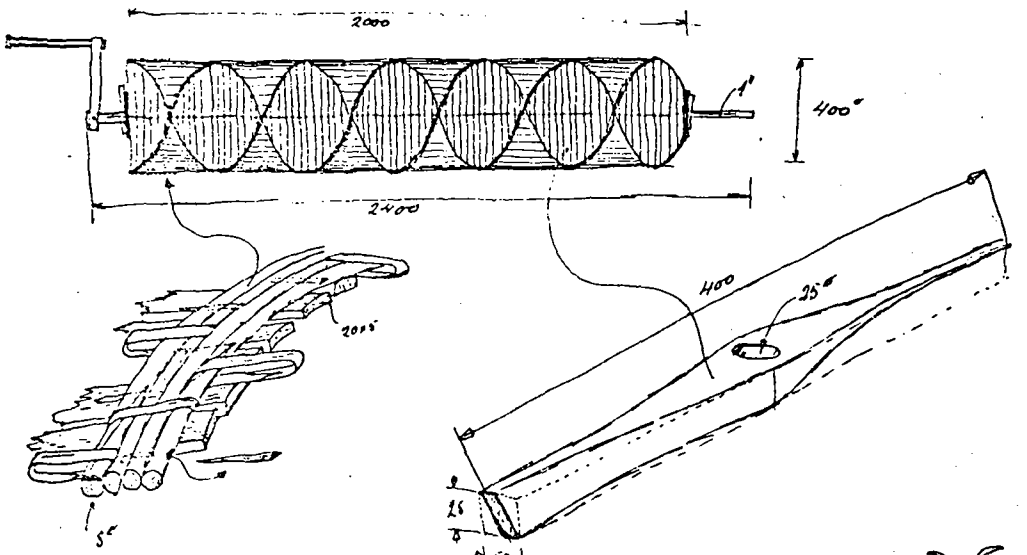


Fig 24 Details of screw. Eighty propellers nailed together form a screw

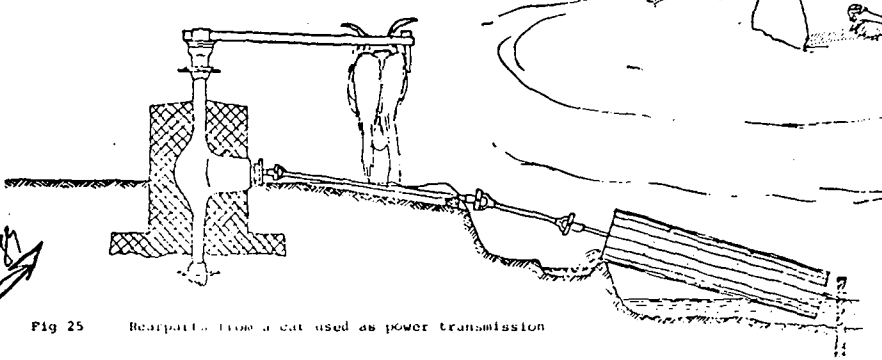


Fig 25 Rear parts from a cart used as power transmission

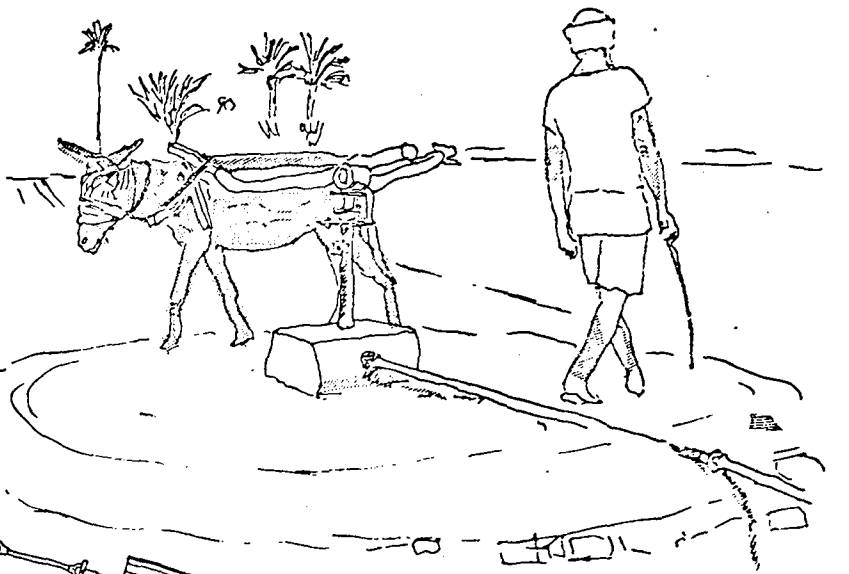


Fig 26 Donkey turns an Archimedean screw

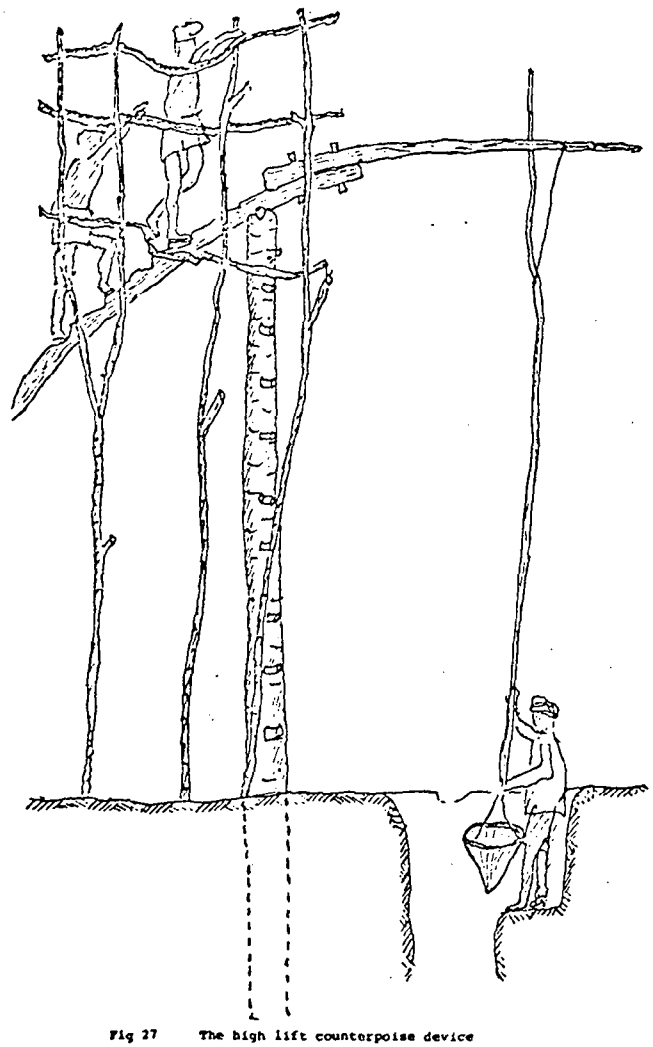


Fig 27 The high lift counterpoise device

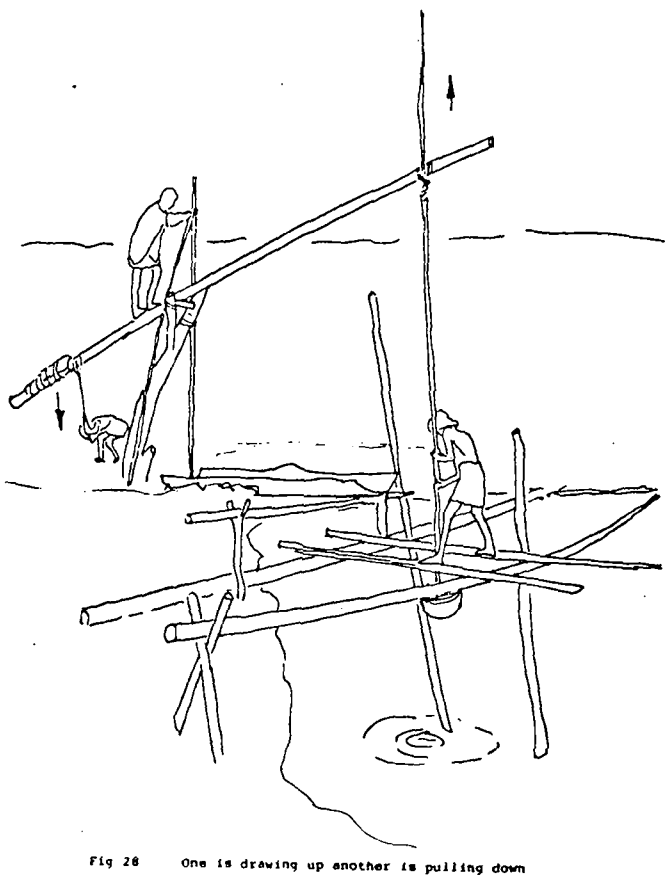


Fig 28 One is drawing up another is pulling down

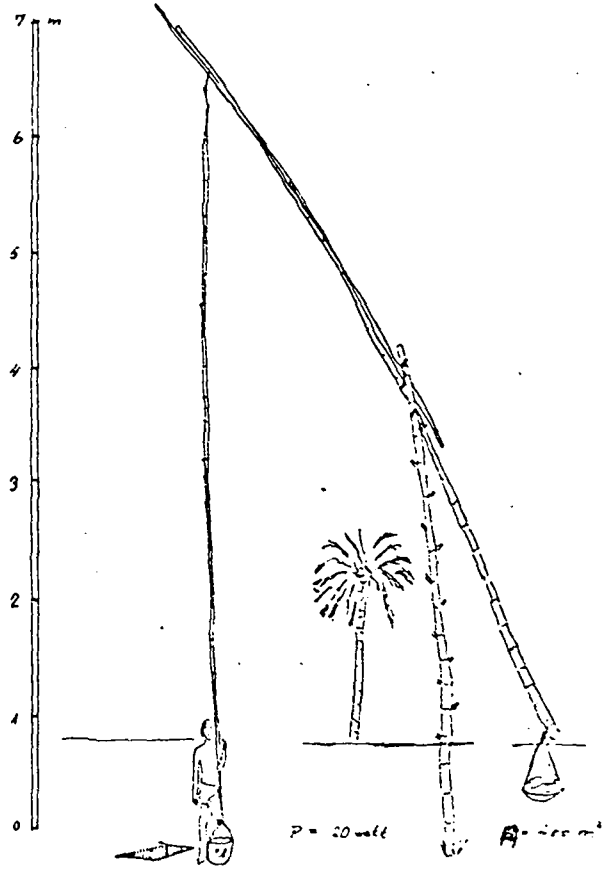


Fig 29 High lift counterpoise for 400 m² garden

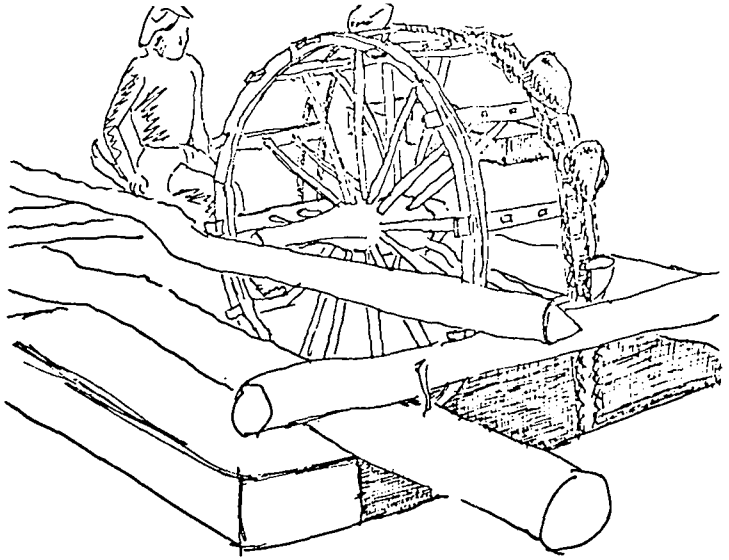


Fig 30 Endless rope with pots (potgarland) worked by the feet

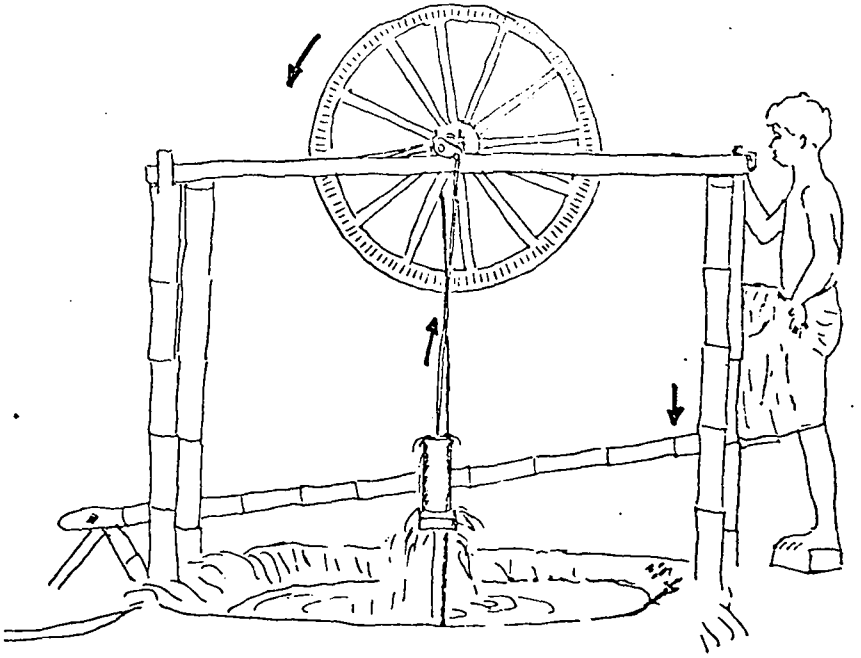


Fig 31 Two views of flywheel construction for a handpump

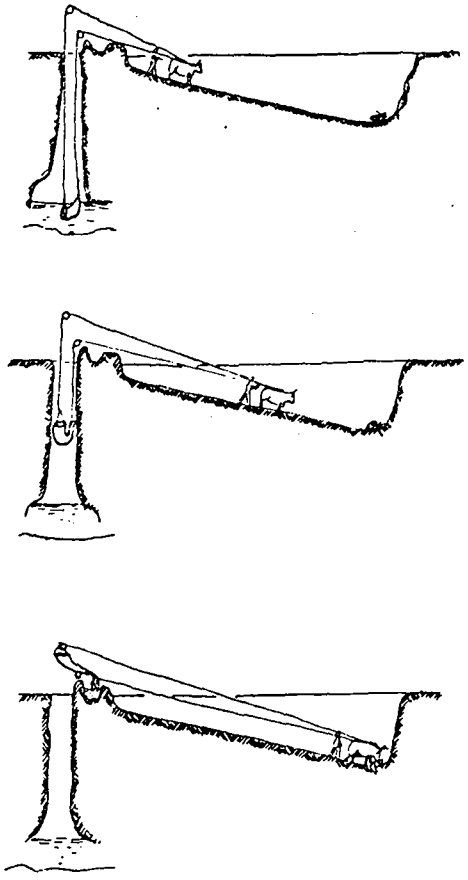


Fig 32 The sack and pulley device. Two ropes or [illegible]

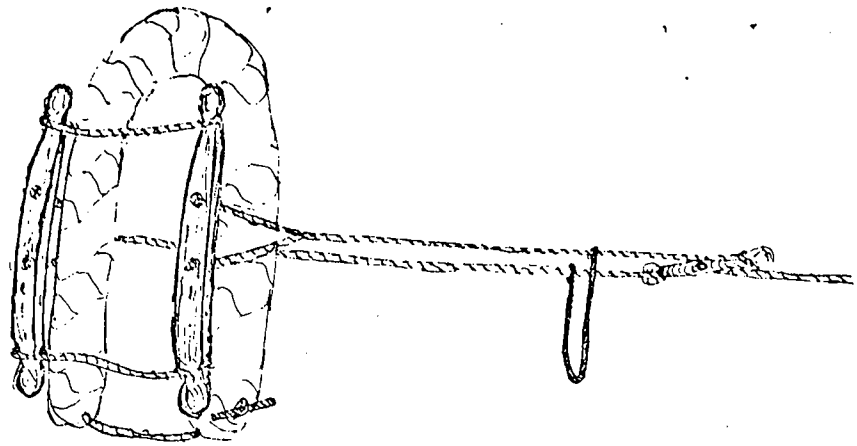
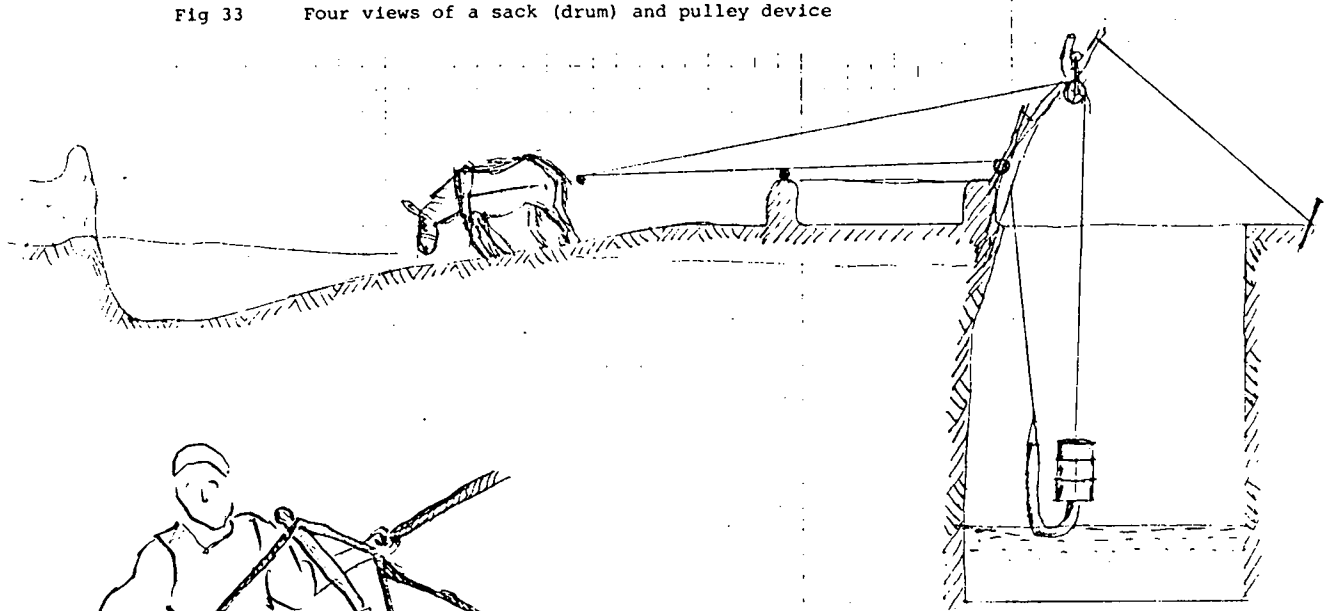
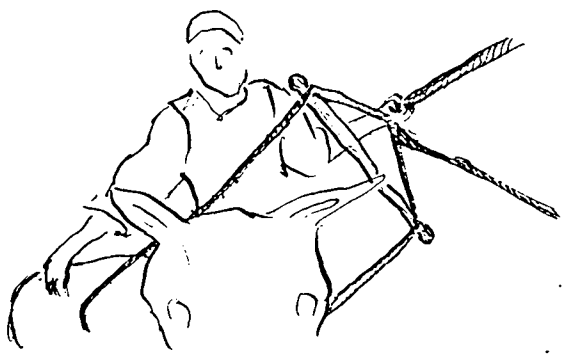
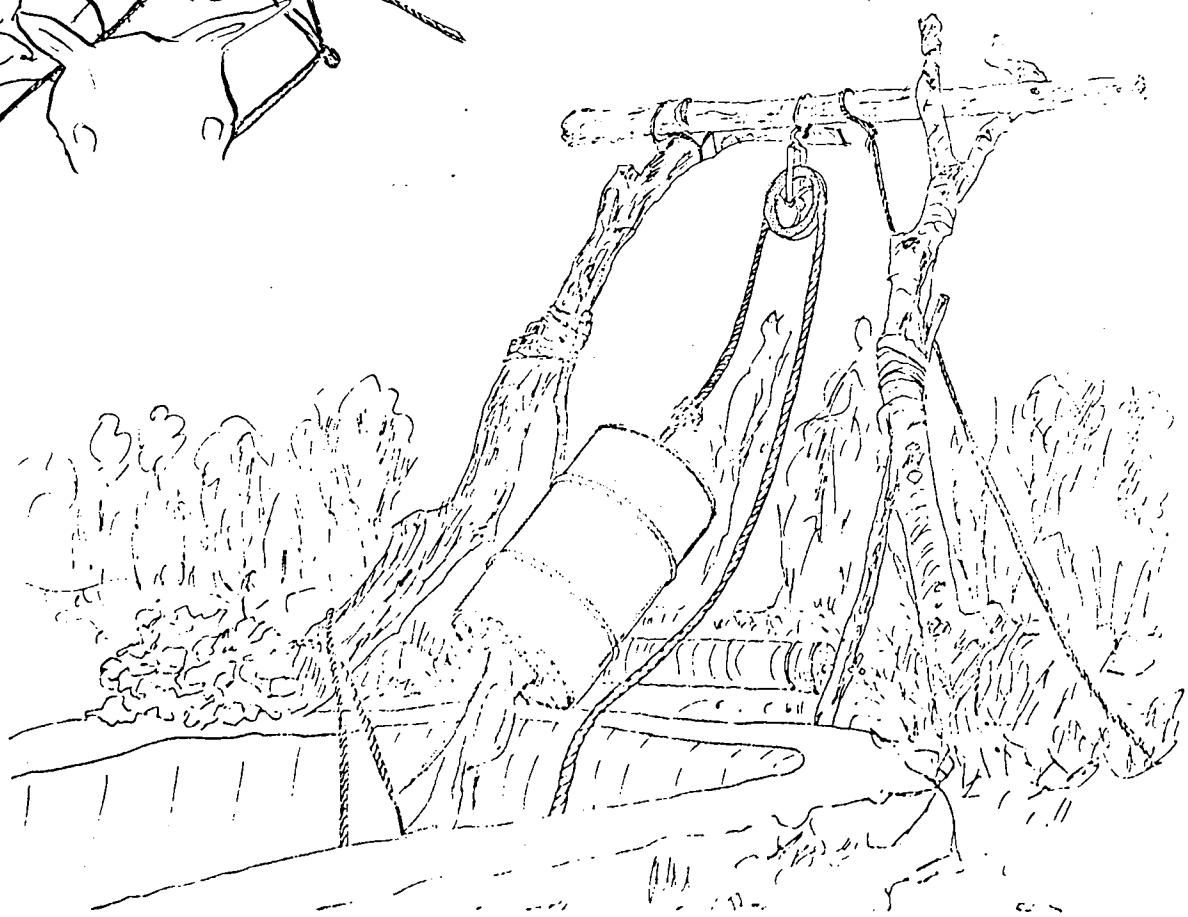


Fig 33 Four views of a sack (drum) and pulley device







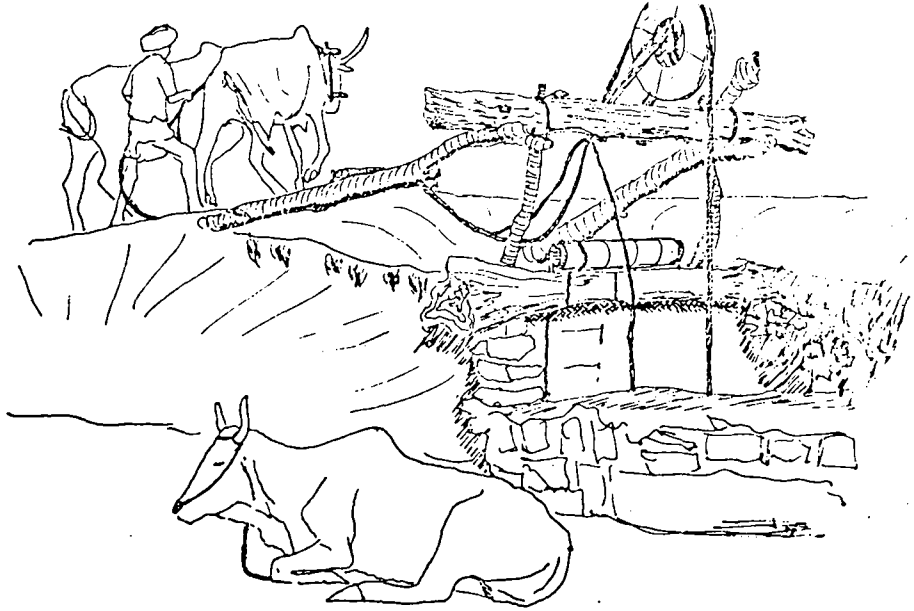


Fig 34 The sack and pulley device (India)

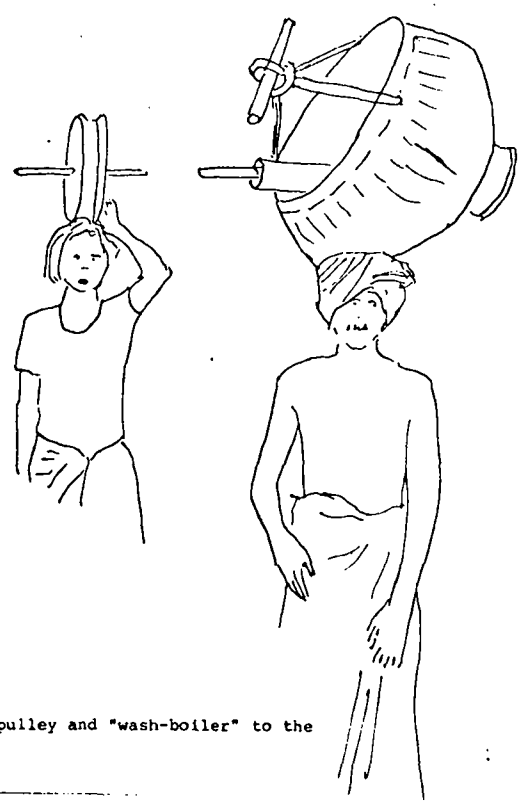
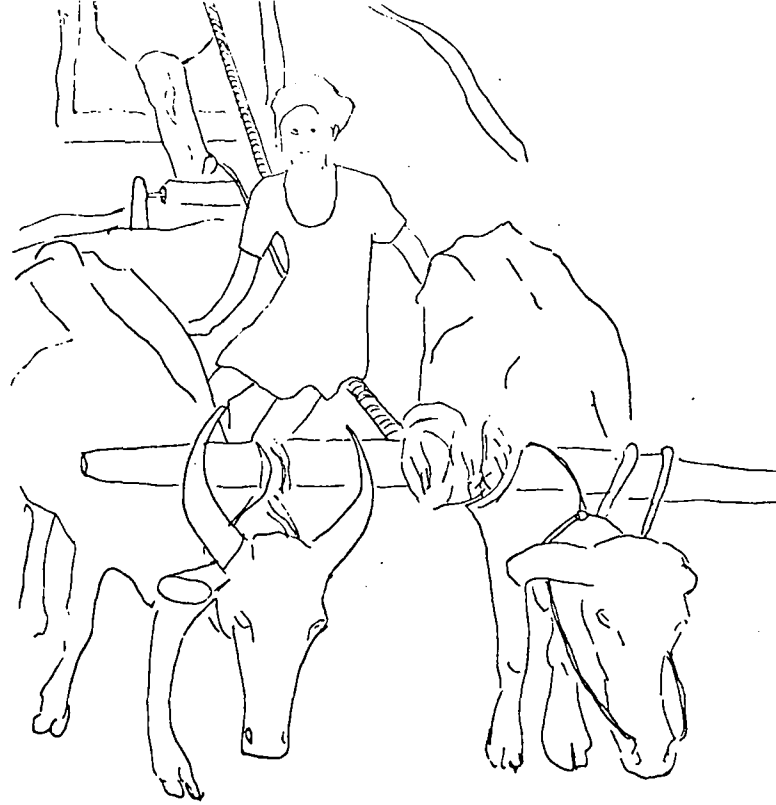


Fig 36 Carrying the pulley and "wash-boiler" to the next well



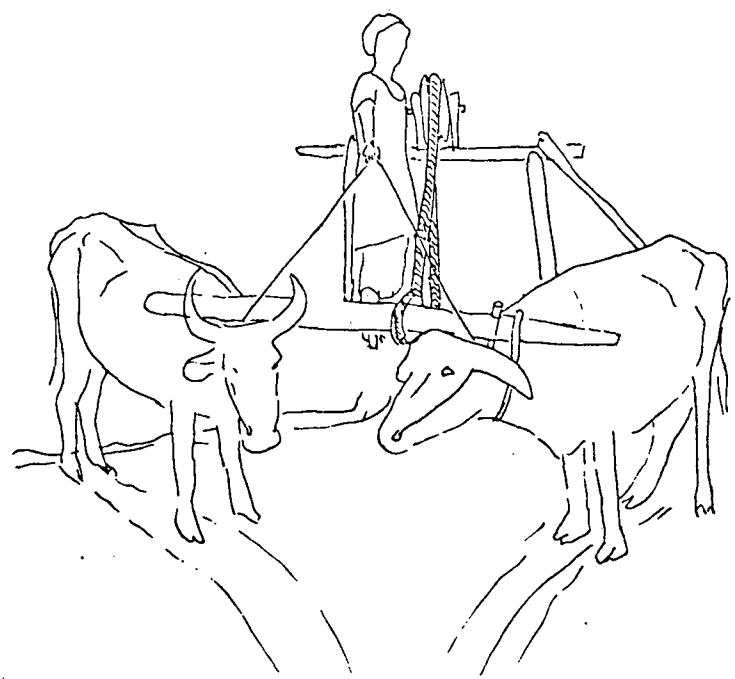


Fig 35 Upper view; pulling down the slope. Lower view: walking back

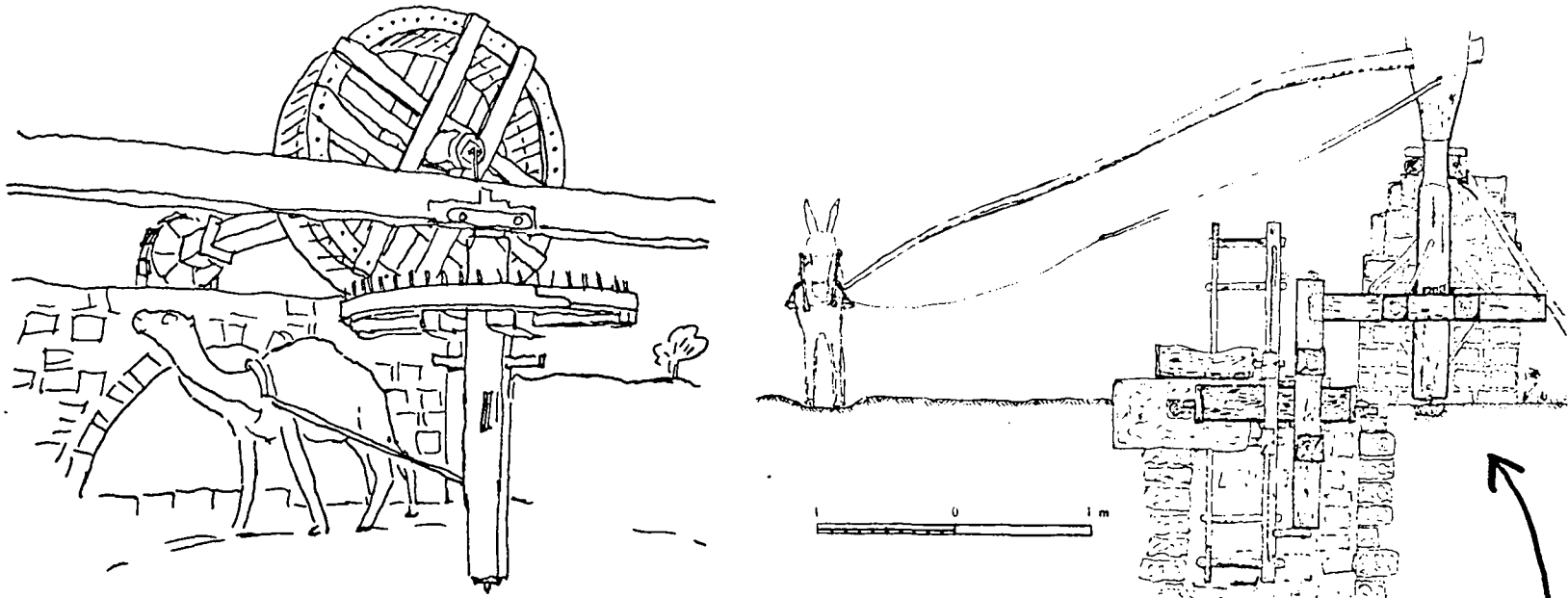
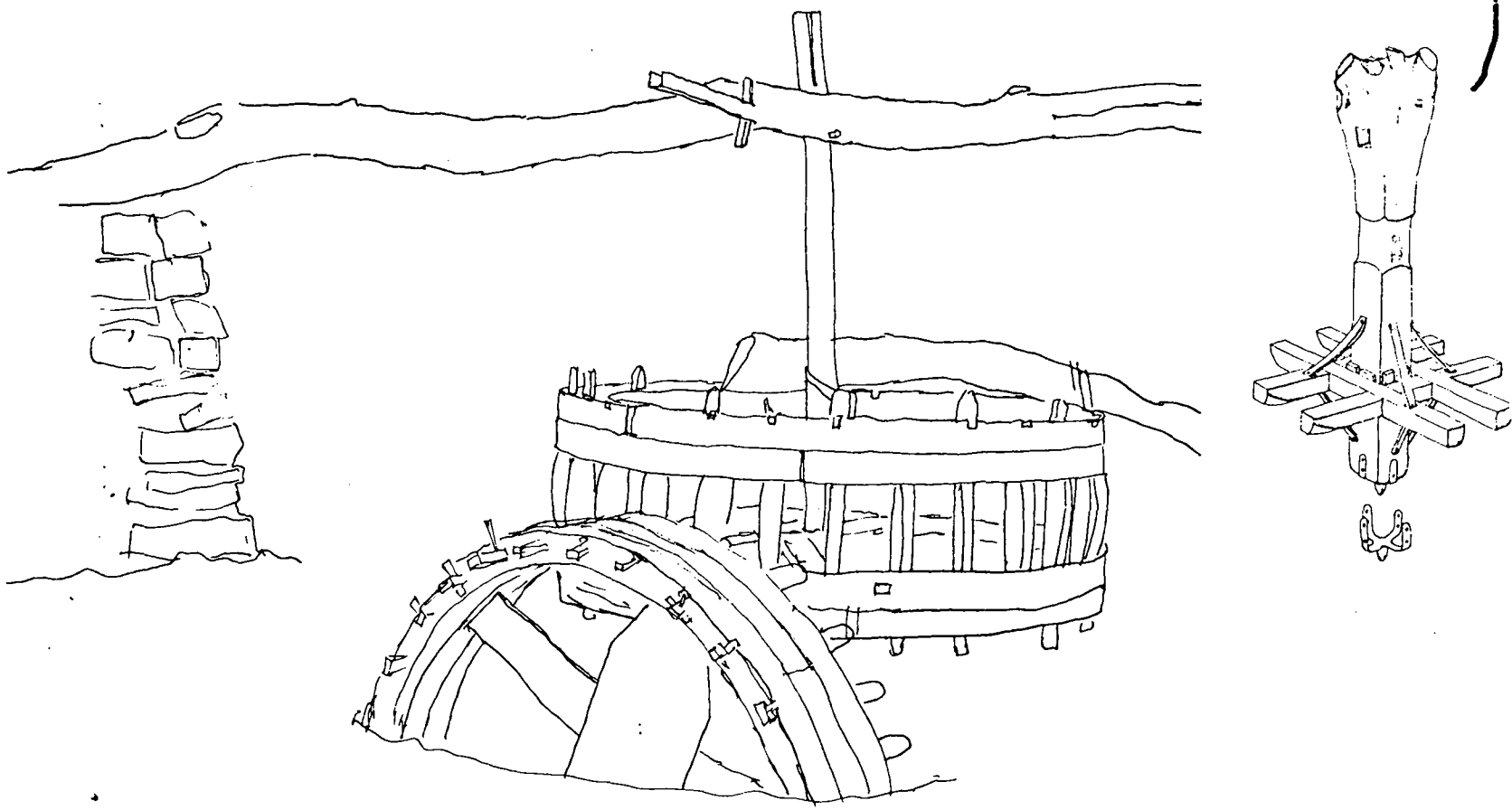


Fig 37 Three views of wooden gear Persian wheel construction



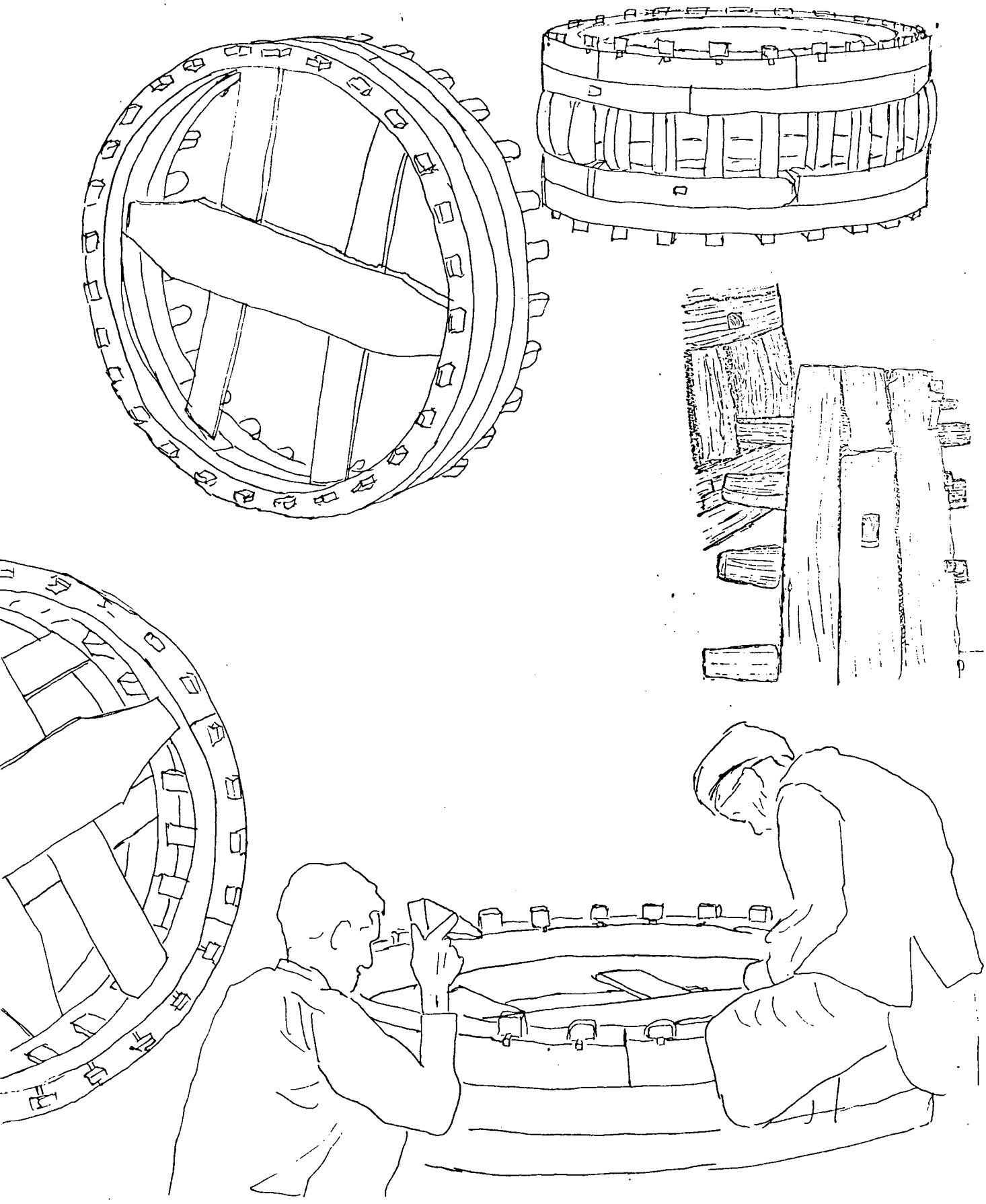


Fig 38 Three views of wooden gear lamminated type

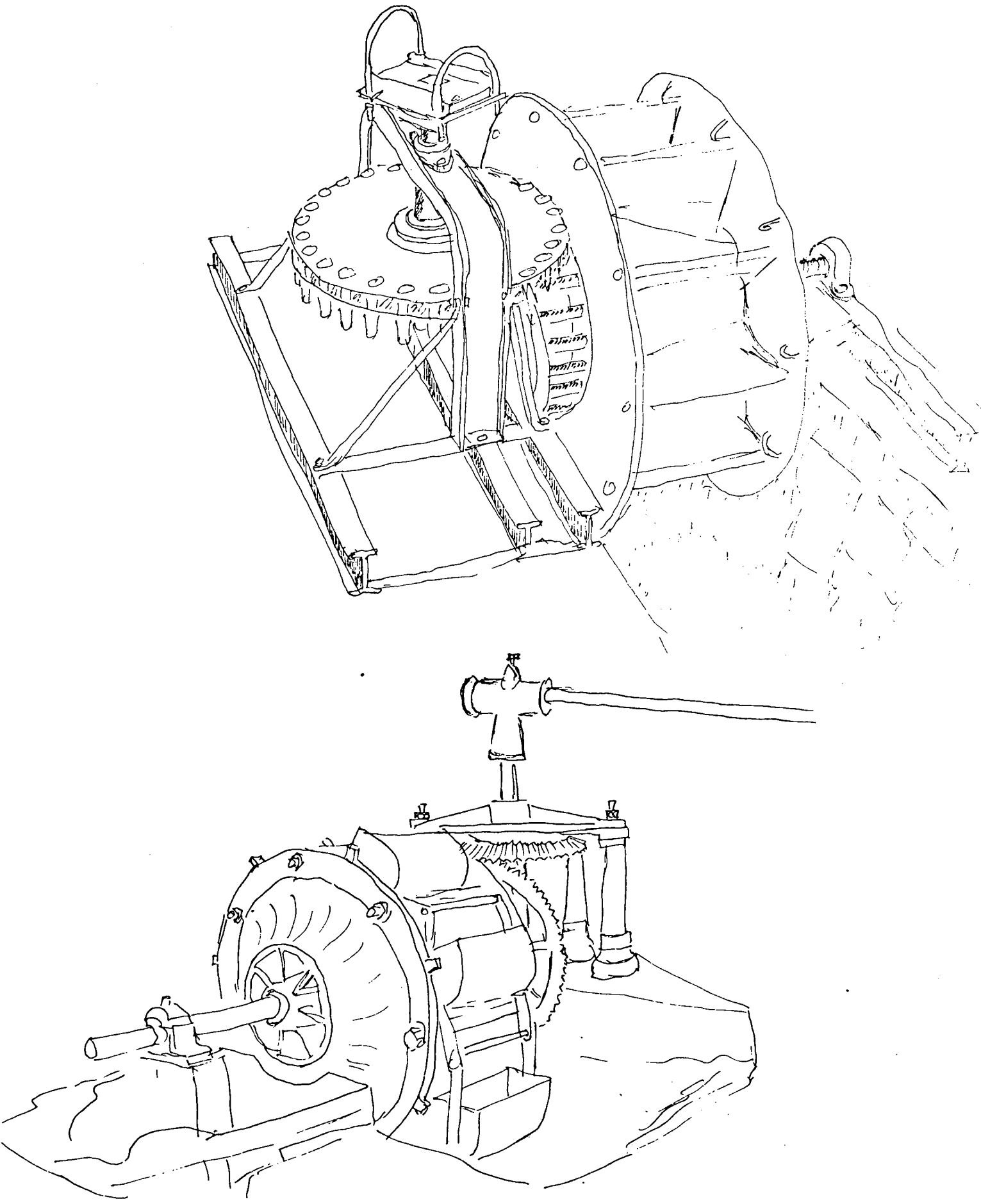


Fig 39 Two views of iron made water wheels

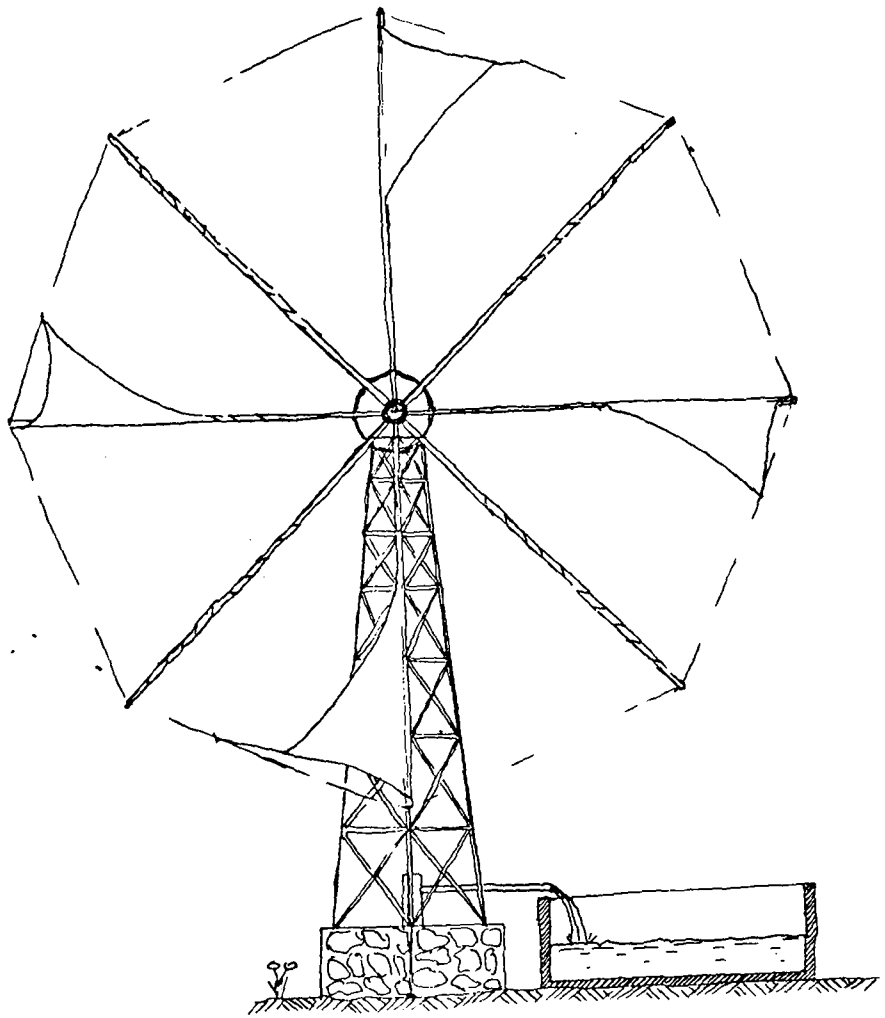


Fig 40a Windmill on Crete. The wind blown sailsarea is reduced because of high speed wind

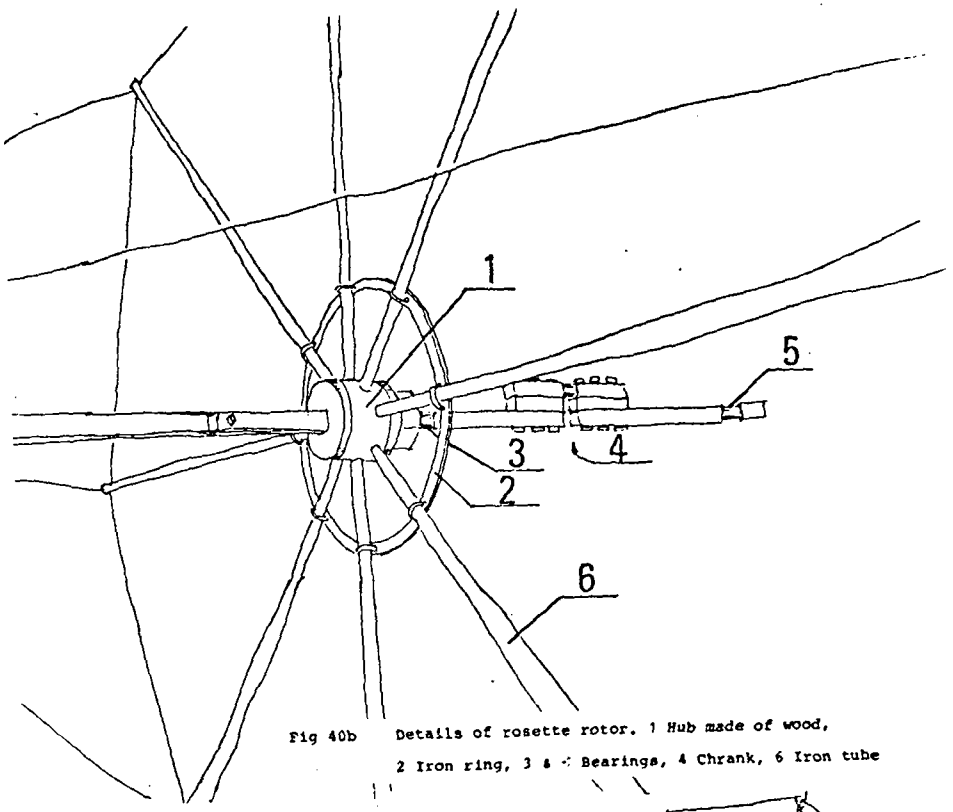


Fig 40b Details of rosette rotor. 1 Hub made of wood, 2 Iron ring, 3 & 4 Bearings, 4 Chrank, 6 Iron tube

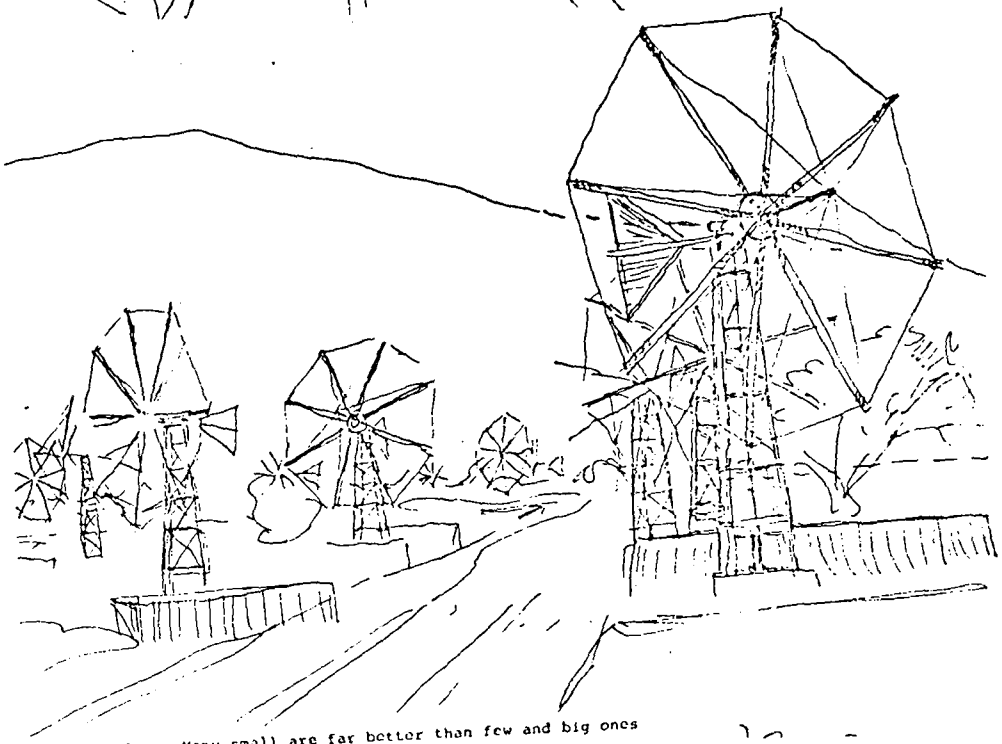


Fig 40c Many small are far better than few and big ones

inch = 2.54 centimetres (cm)
inch = 0.0833 feet
foot = 12 inches
foot = 30.5 centimetres
metre = 39.4 inches
metre = 3.28 feet
mile = 1.61 kilometres (km)

$foot^2$ = 0.093 $metres^2$ (m^2)
$metre^2$ = 10.76 $feet^2$
acre = 43 560 $feet^2$
acre = 0.405 hectares (ha)
hectare = 107 630 $feet^2$
hectare = 2.47 acres
acre = 0.97 feddan

$foot^3$ = 0.0283 $metres^3$ (m^3)
$foot^3$ = 7.48/6.23 US/Imp. gallons
$foot^3$ = 8.33 pounds water
$metre^3$ = 35.3 $feet^3$
$metre^3$ = 264/220 US/Imp. gallons
$metre^3$ = 8.11×10^{-4} acre feet
litre = 0.0353 $feet^3$
litre = 10 newtons water
hectare centimetres = 0.973 acre-inches
kilo litre = $metres^3$

kilopond ≙ 10 newtons (N)
pound = 4.44 newtons
the force on a kilogram is 2.20 pounds

kilogram (mass) = 0.0685 slugs

metre/second = 3.6 kilometres/hour (km/h)
metre/second = 3.28 feet/second
metre/second = 2.24 miles/hour
kilometre/hour = 1.6 miles/hour

$newton/metre^2$ = pascal
metre water ≙ 0.1 atmospheres

foot water ≙ 0.305 metre water
$pound/inches^2$ = 0.068 atmosphere
atmosphere = 14.7 $pound/inches^2$

joule=watt second = 0.238 calories (cal)
kilowatt hour = 3600 kilojoule (kWh) (kJ)
kilowatt hour = 860 kilocalories (kcal)
calorie = 4.186 joule (J)
in metabolism Cal = 1000 calories
foot pound = 1.356 joule
British thermal unit = 1055 joule

horsepower = 746 watts (W)
metric horsepower = 736 watts
footpound/second = 1.356 watts
watt = joule/second = newton metre/sec (Nm/s)

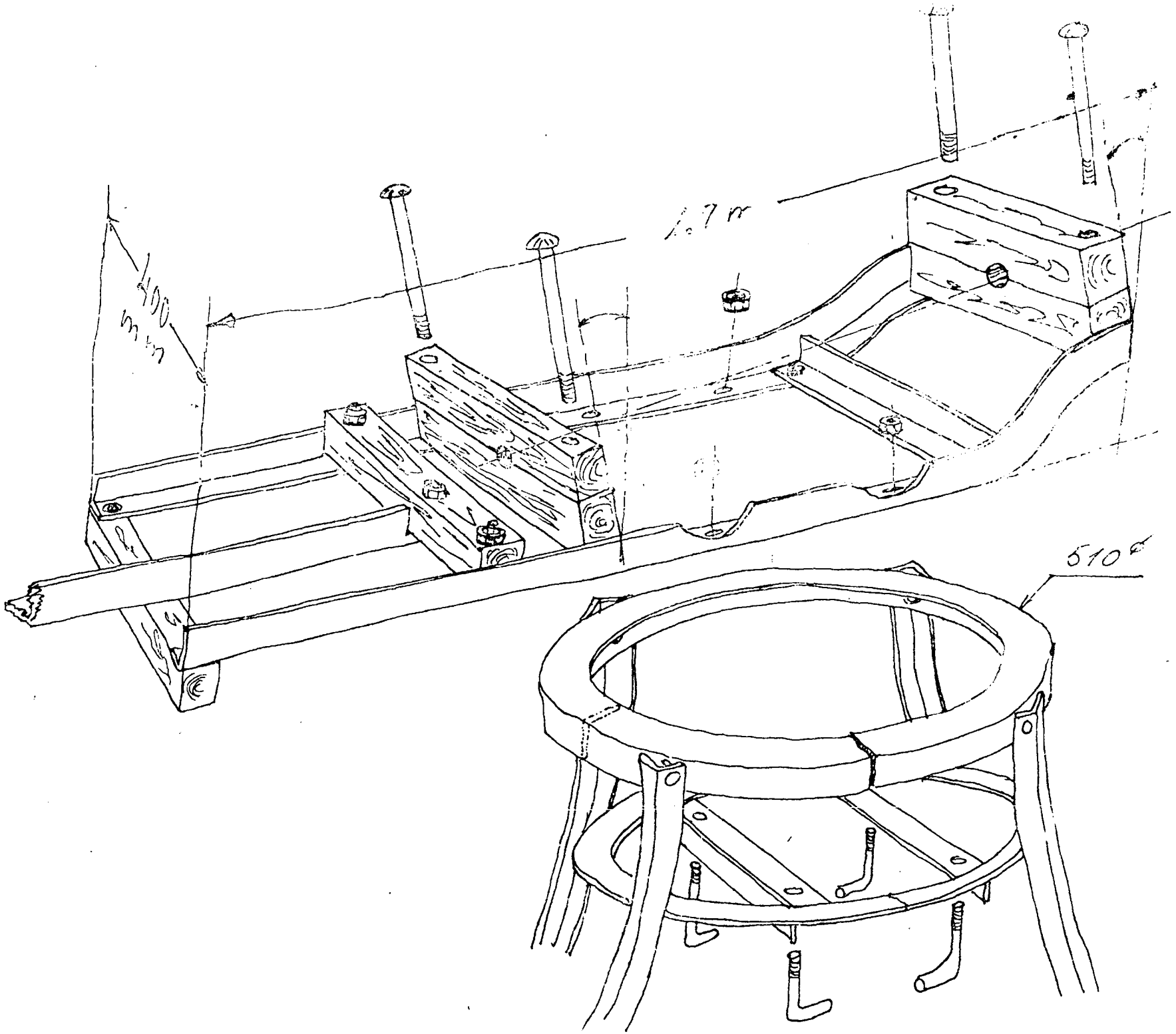
$feet^3$/second = 375 Imp. gal/minute
$feet^3$/second ≙ 1 acre inches/hour
$feet^3$/second ≙ 102 $metres^3$/hour (m^3/h)
litre/second = 306 $metres^3$/hour

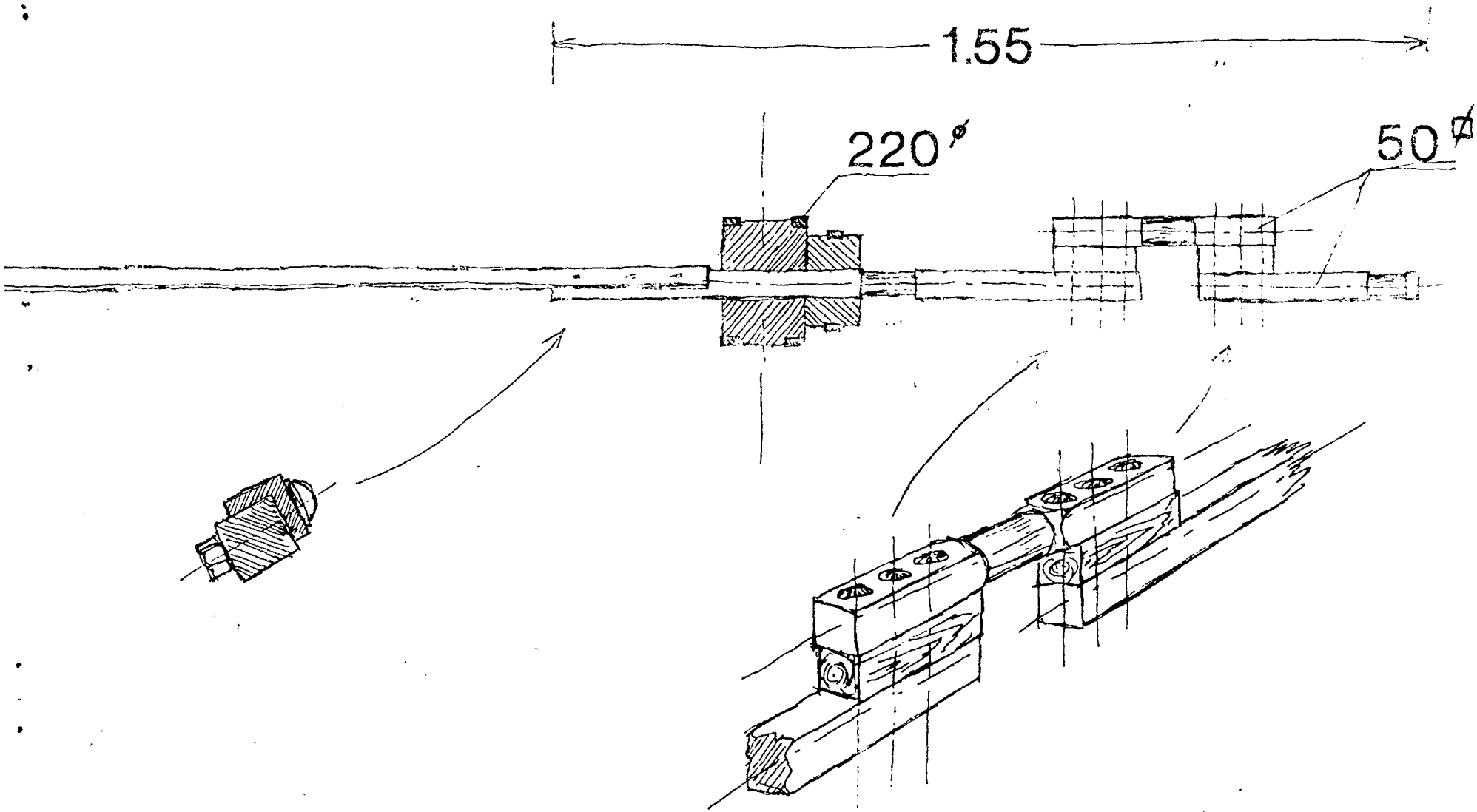
water power = flow x water head
newton/second x metres = water watts
litres/second x metres x 10 = water watts
$feet^3$/second x feet x 84.7 = water watts
Imp. gal/minute x feet x 0.226 = water watt
$metres^3$/hour x metres x 2.77 = water watts

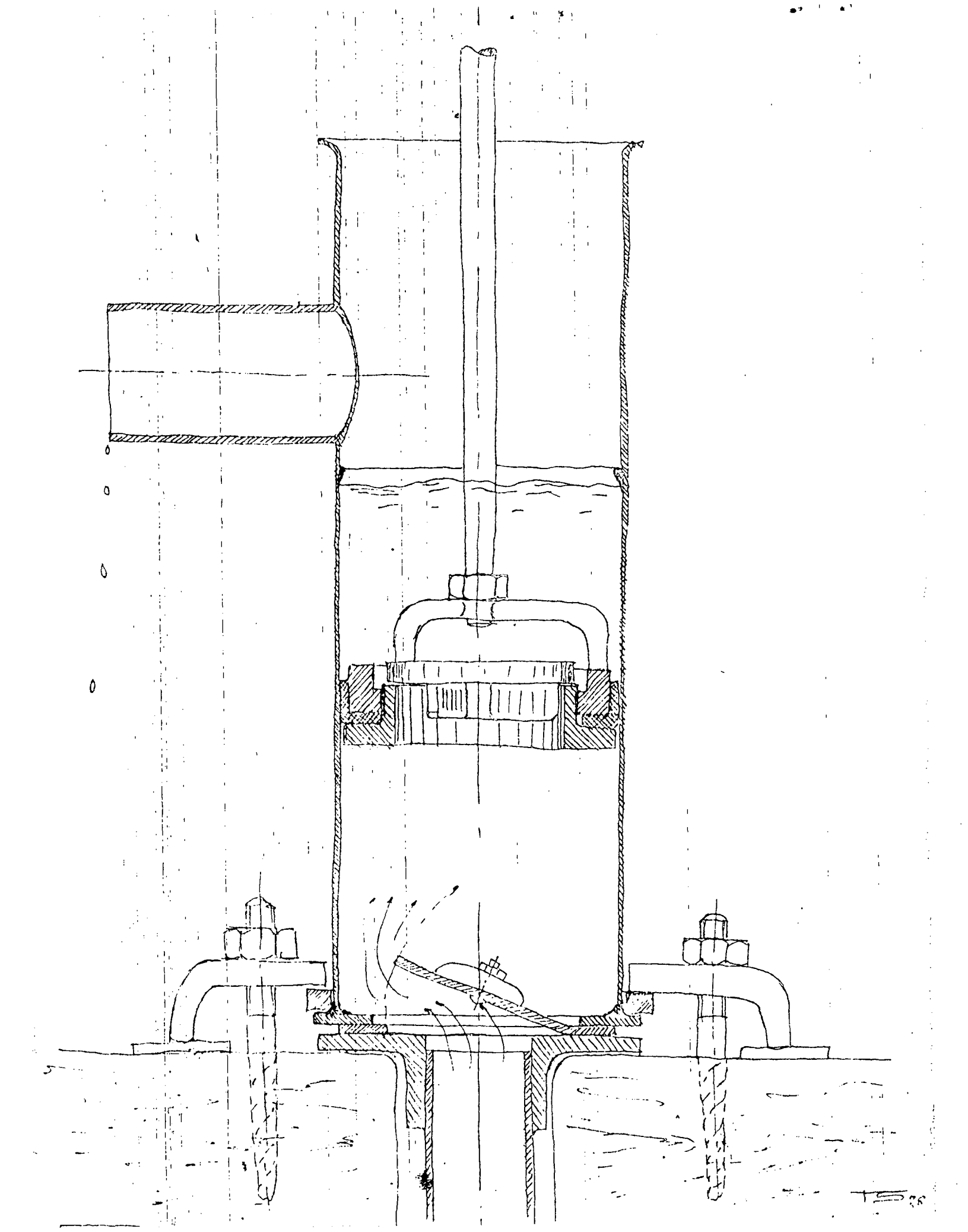
gravity = 9.8 $metre/second^2$ (m/s^2)
gravity = 32.2 feet/second2

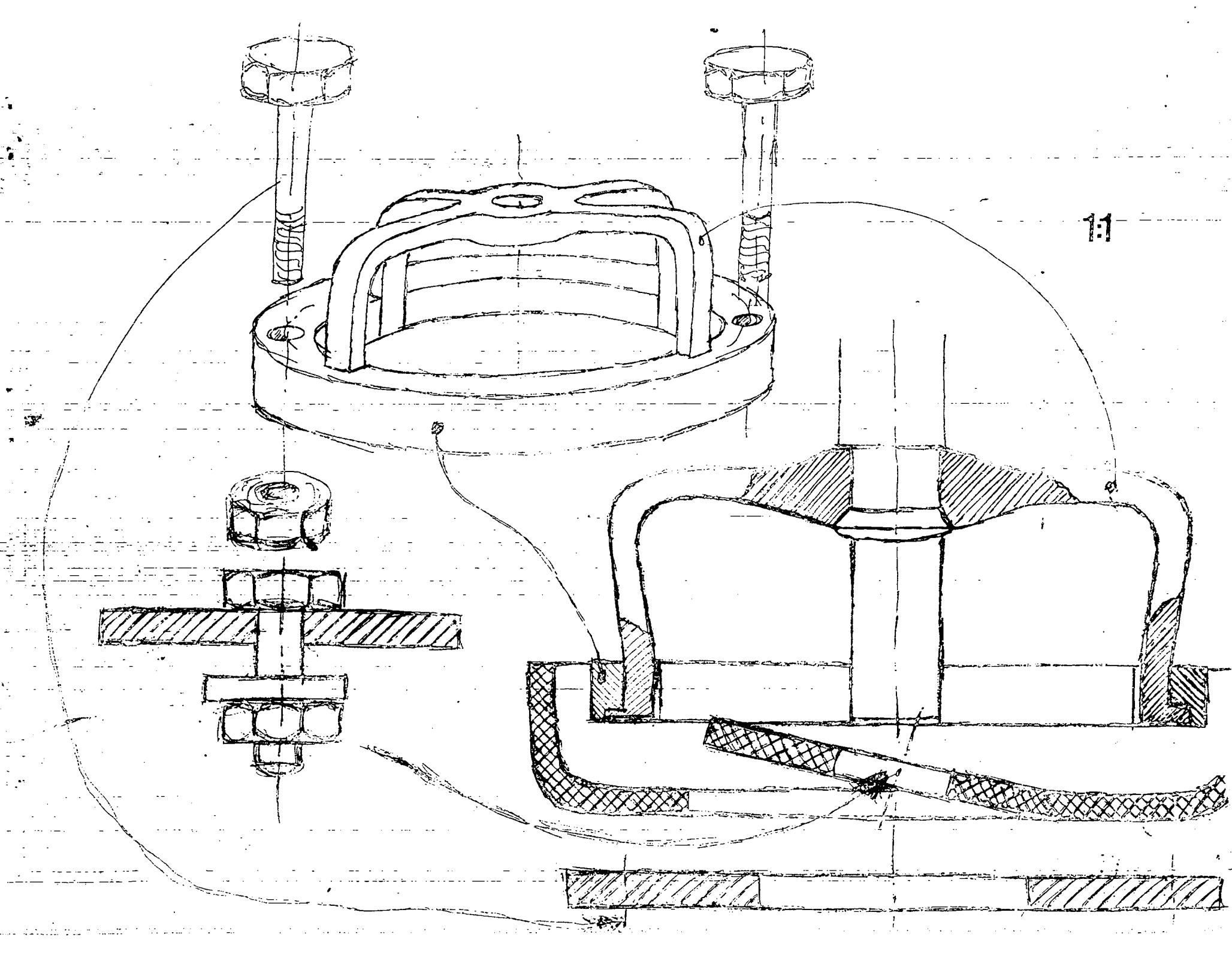
power from man or beast in 10 minutes is
1.1 watts/kilogram weight of body

convenient logaritmic scale =
1-1.25-1.6-2-2.5-3.15-4-5-6.3-8-10


1.7 m
510 ø


1.55
220ø
50ø




1:1

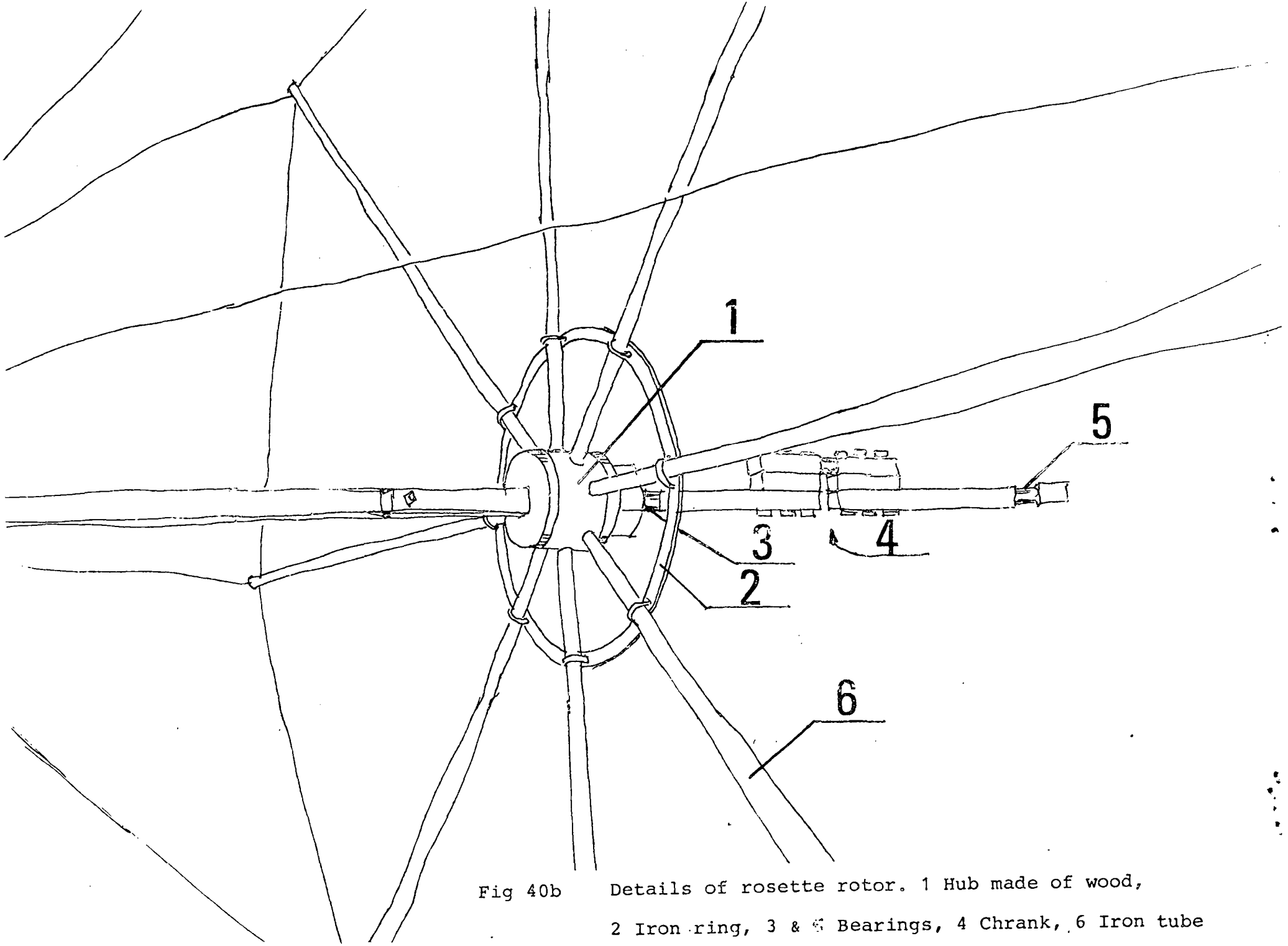
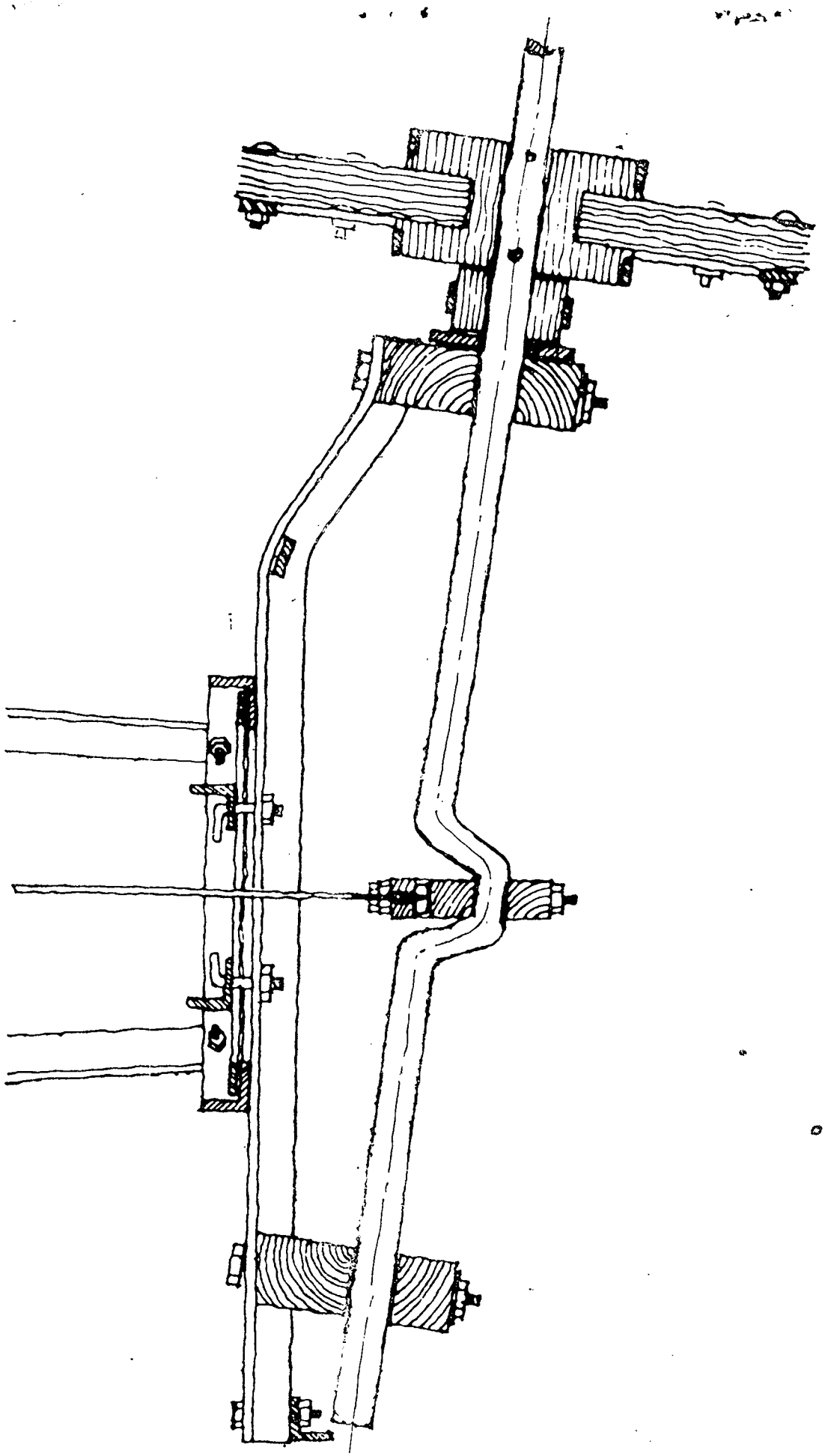
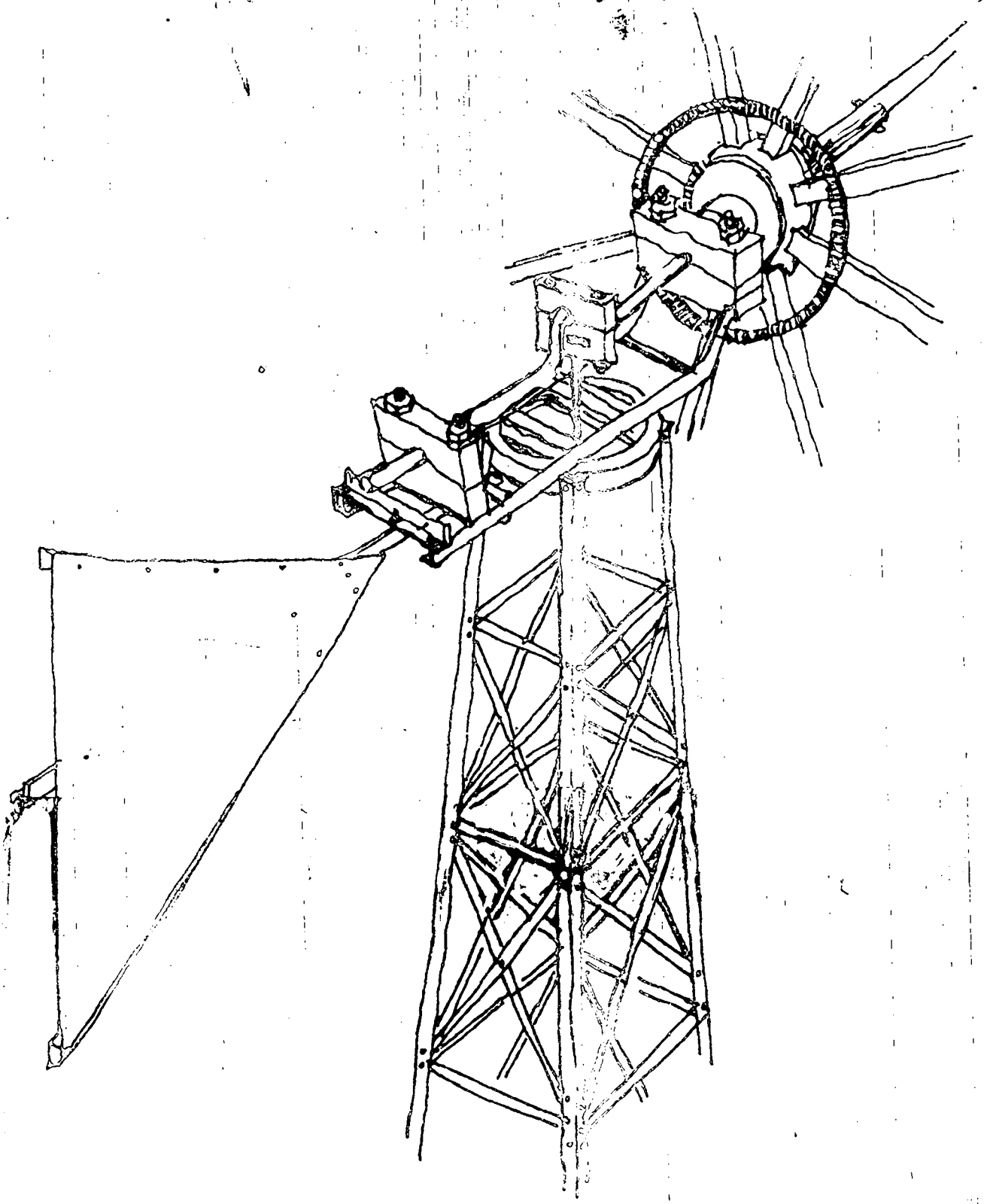
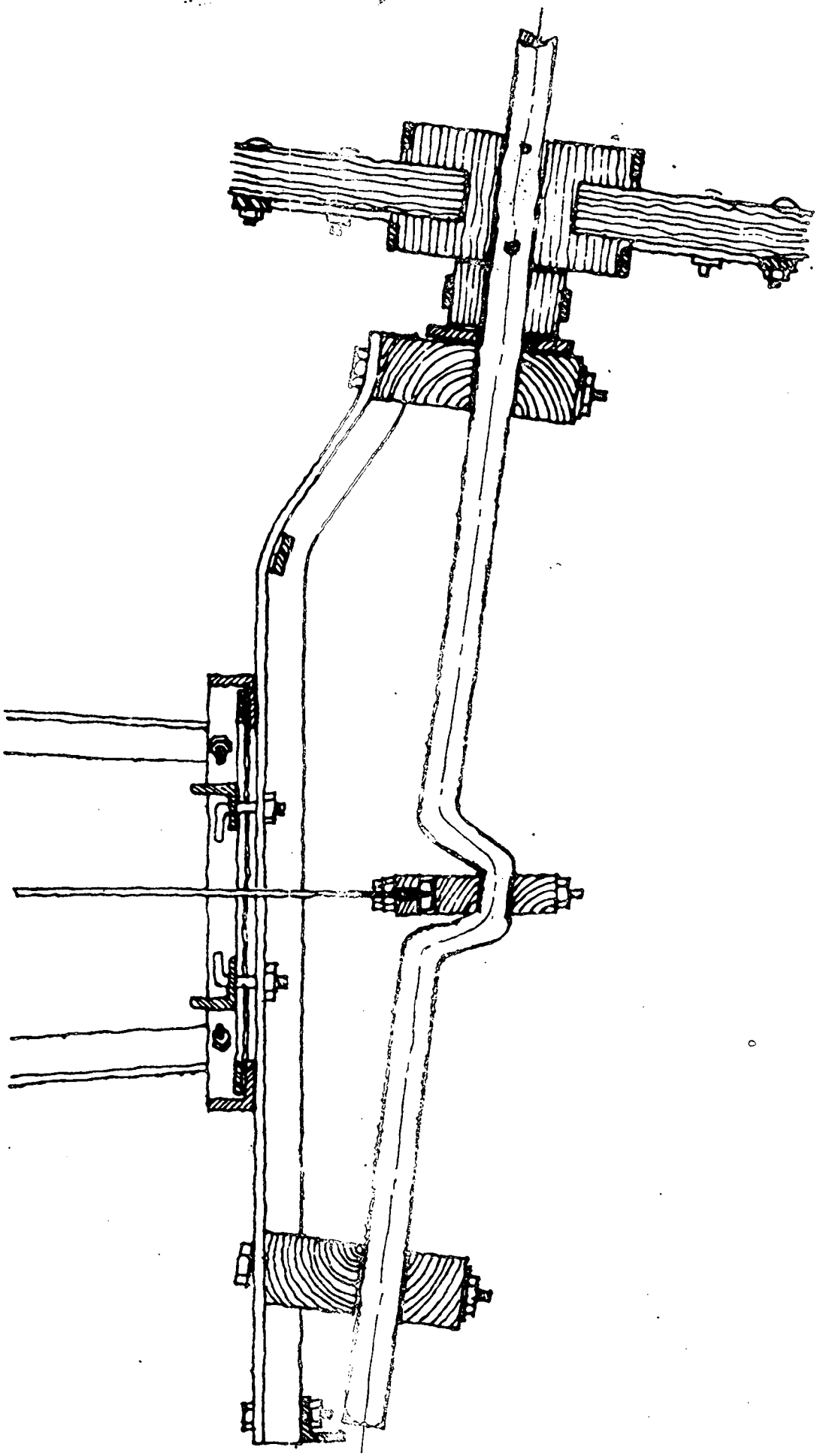
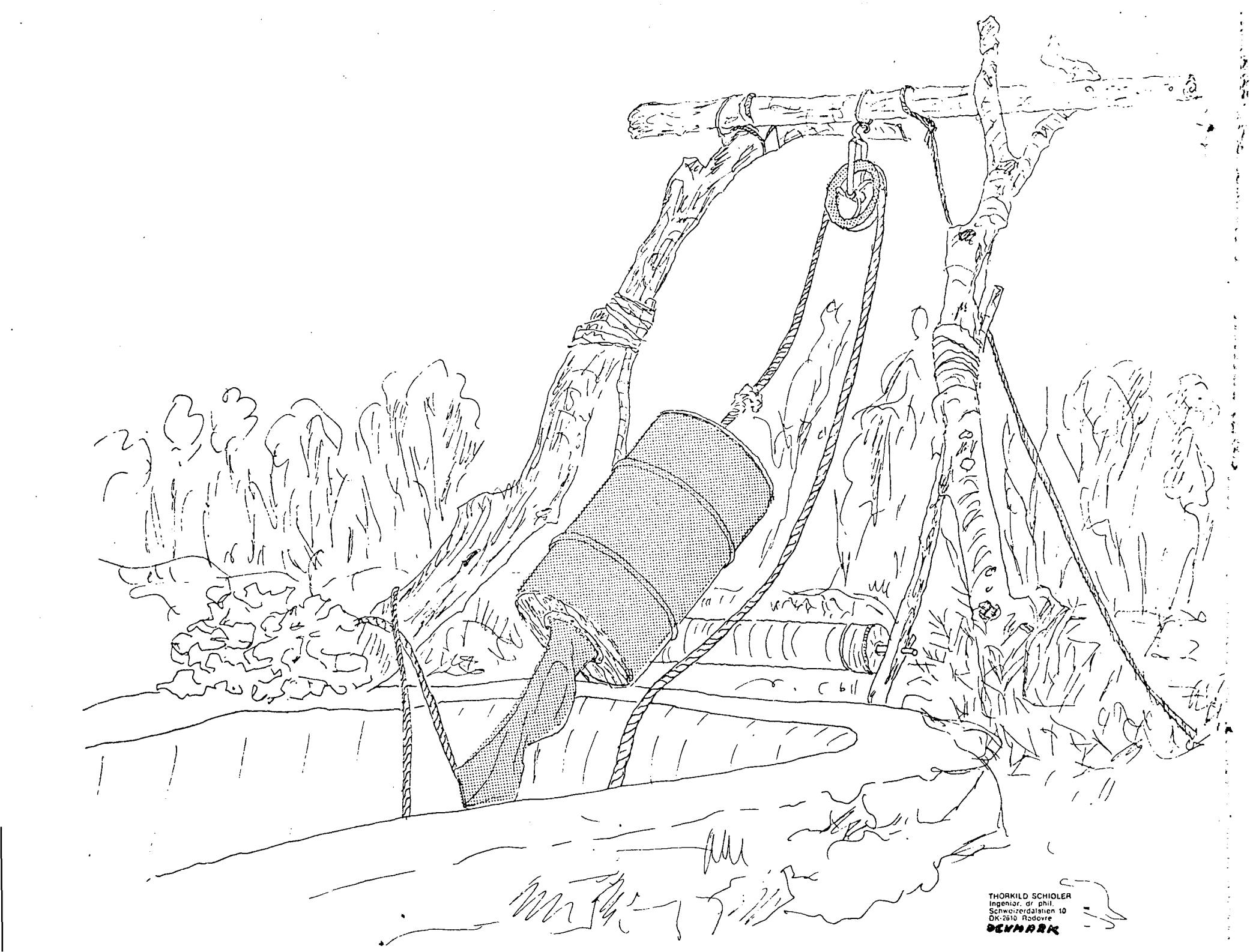


Fig 40b Details of rosette rotor. 1 Hub made of wood, 2 Iron ring, 3 & 5 Bearings, 4 Chrank, 6 Iron tube









THORKILD SCHIOLER
Ingeniør, dr. phil.
Schweizerdalsvej 10
DK-2610 Rødovre
DENMARK