

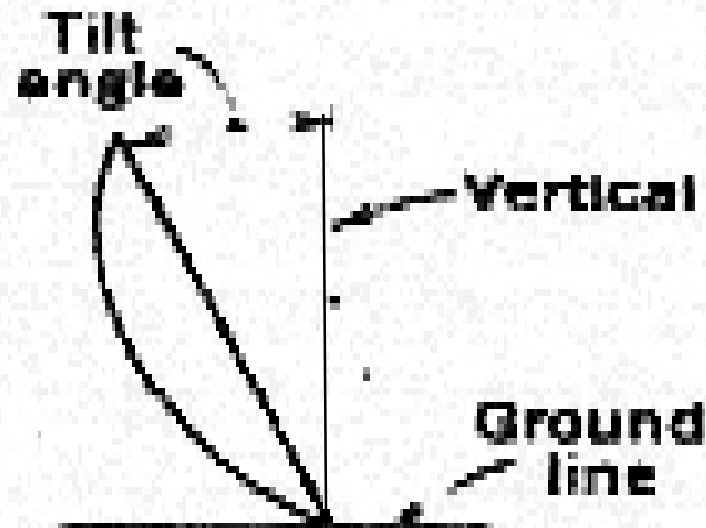
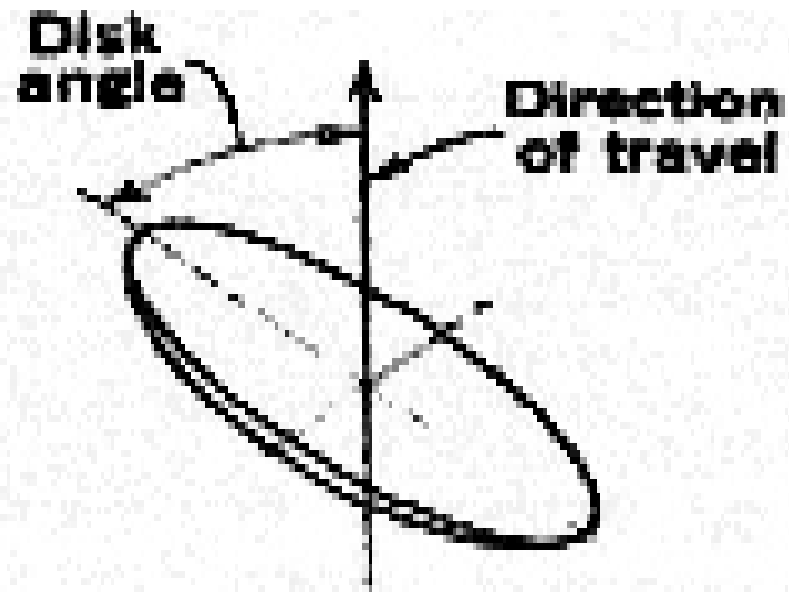


**Tractor drawn disk plow**

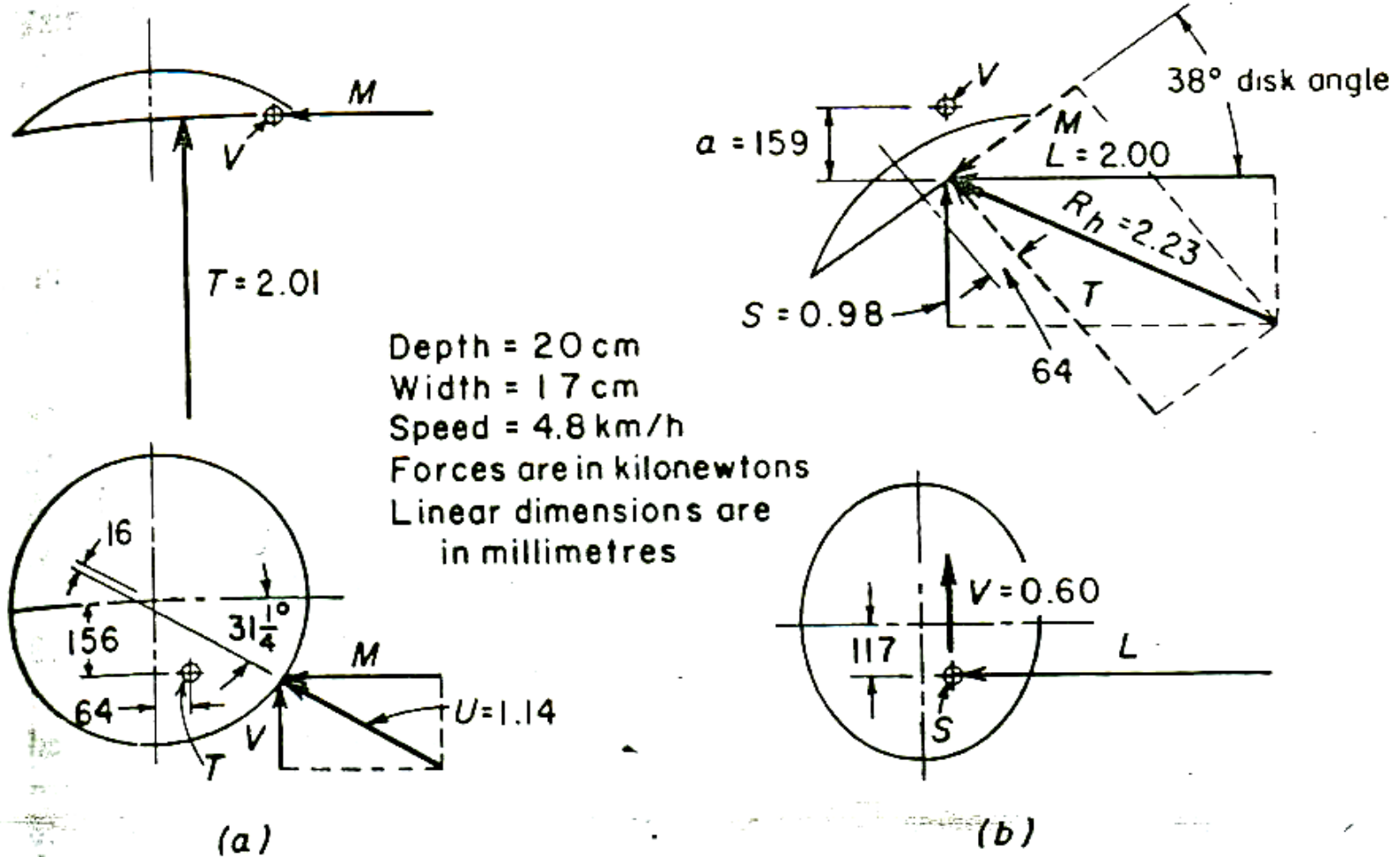




**Offset disc harrow with plane disks and notched disks**



**Fig. 3 Disk and tilt angles for a plow disk.**



**Fig. 4 Example of resultant soil forces acting upon a 61-cm vertical disk blade under field conditions in a silt loam soil, the total effect being represented by two nonintersecting forces: (a) a thrust force  $T$ , plus a radial force  $U$ , and (b) a horizontal force  $R_h$ , plus a vertical force  $V$ .**

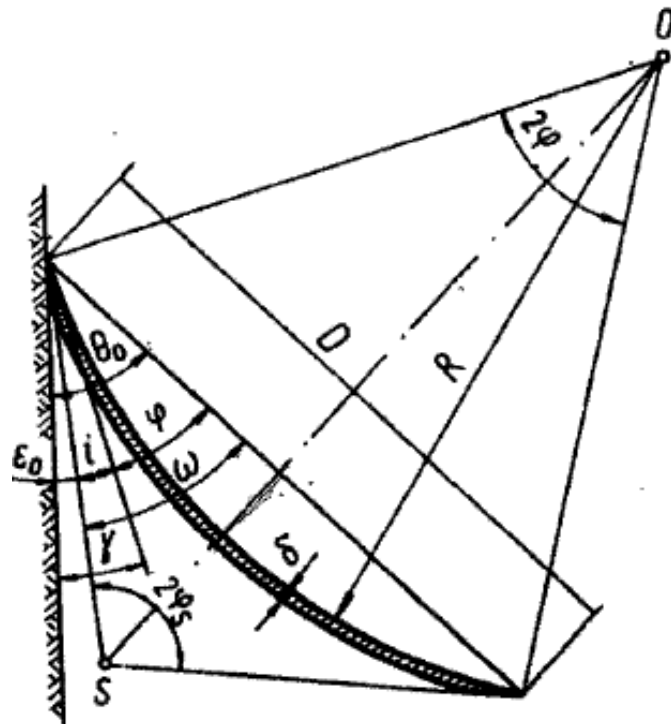


Fig. 6.78. Parameters of disk of a plow and of a harrow.

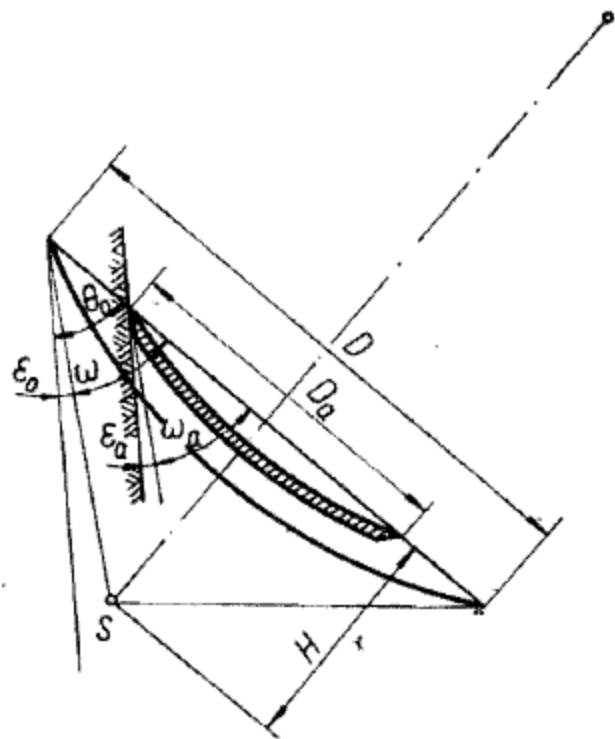


Fig. 6.77. Cross section of the disk on the plowing depth.

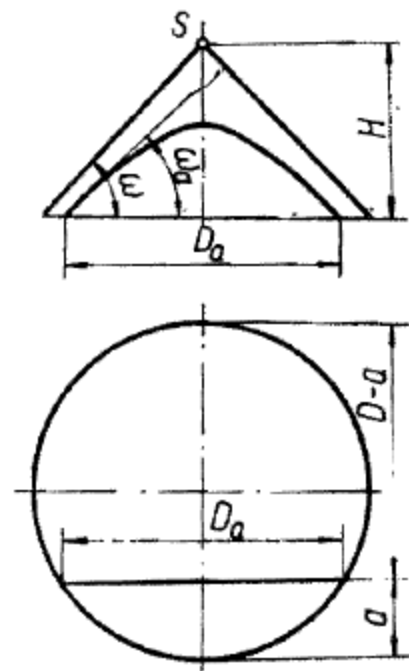


Fig. 6.78. Determination of the diameter  $D_0$  of the disk.

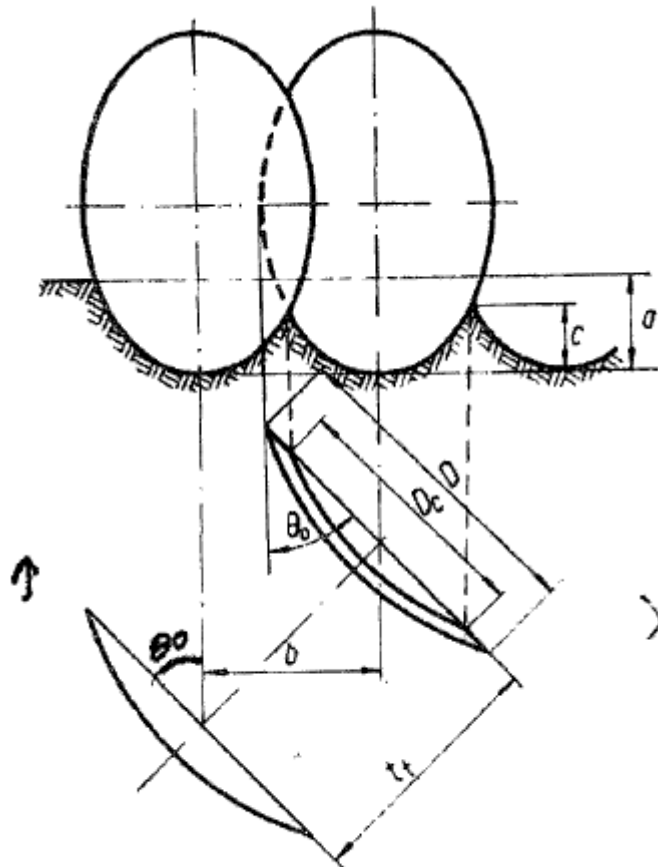


Fig. 6.80. Spacing of perpendicular disks.

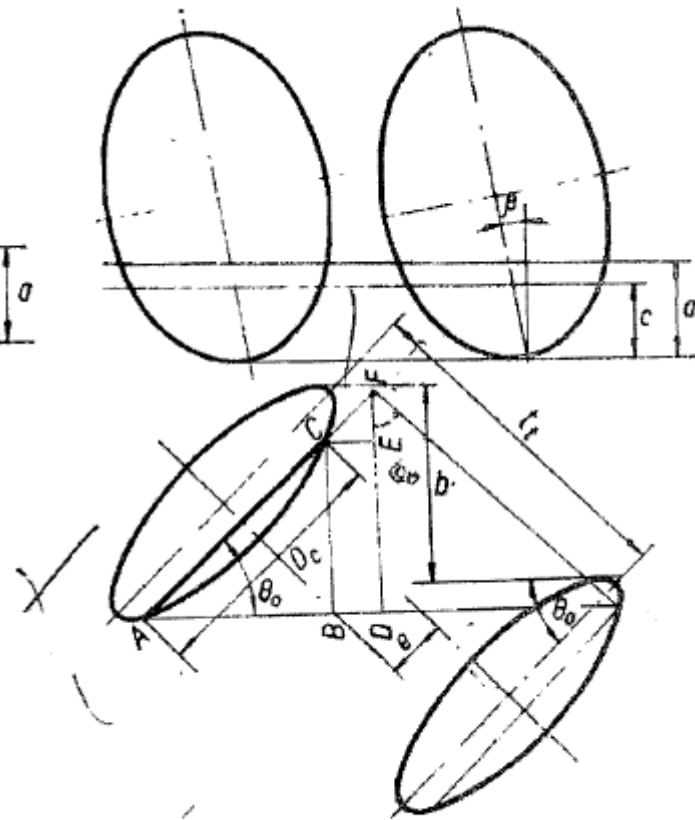


Fig. 6.81. Spacing of inclined disks.

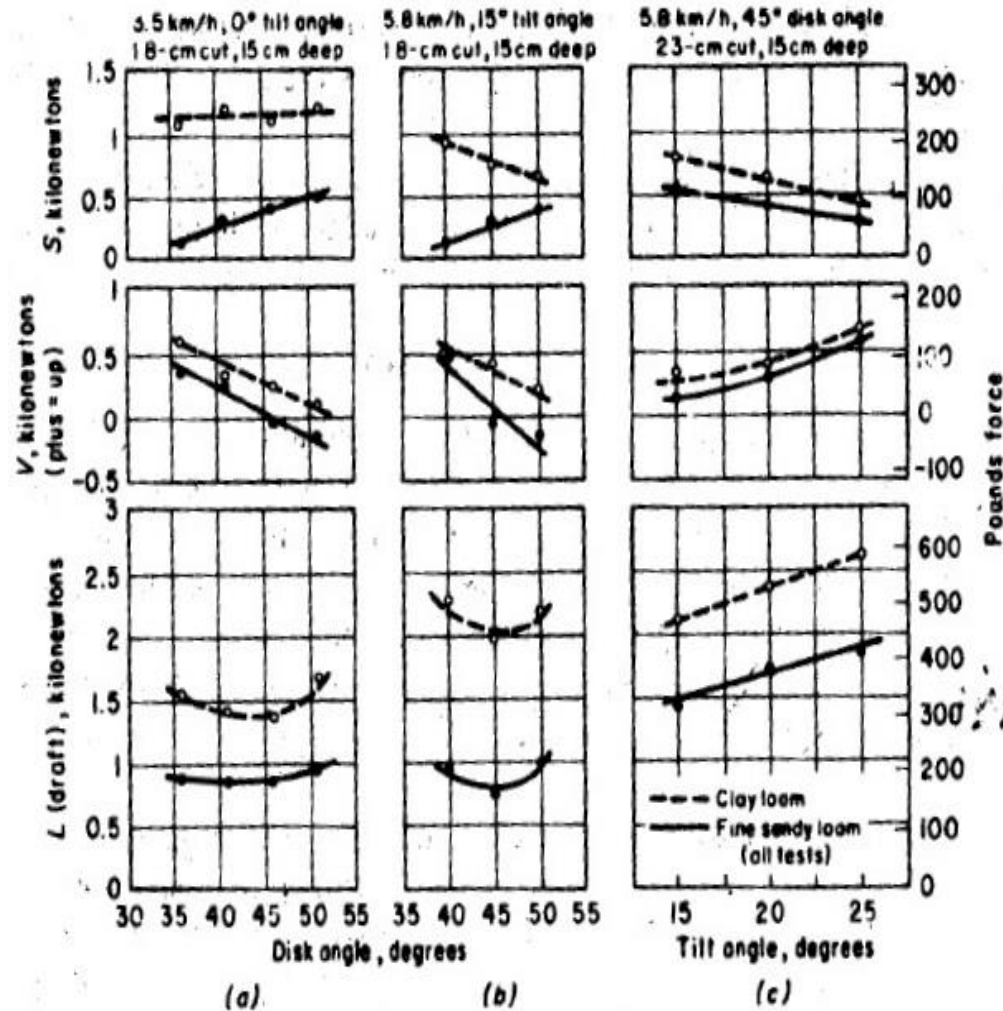


Fig. 3. Effect of disc angle and tilt angle on draft, vertical upward force and side force.



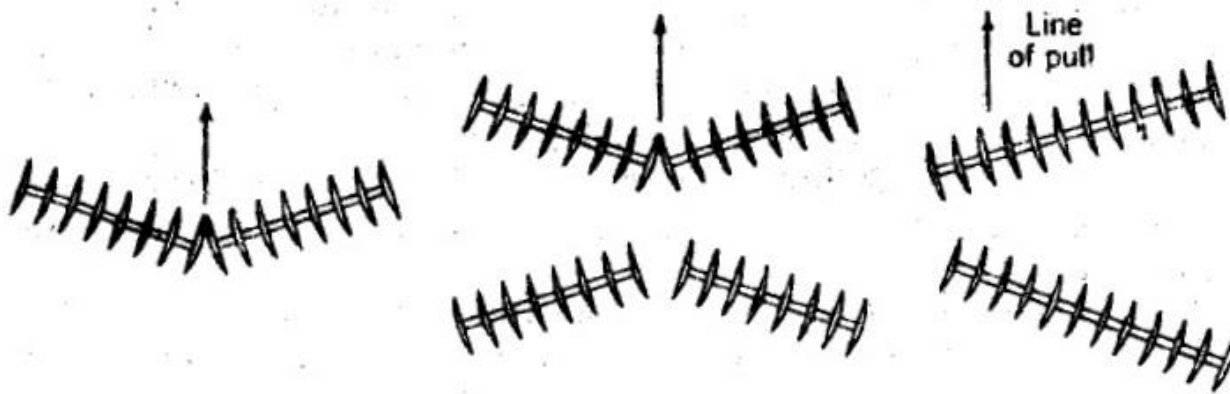


Fig. 4. Gang arrangement for disc harrows.

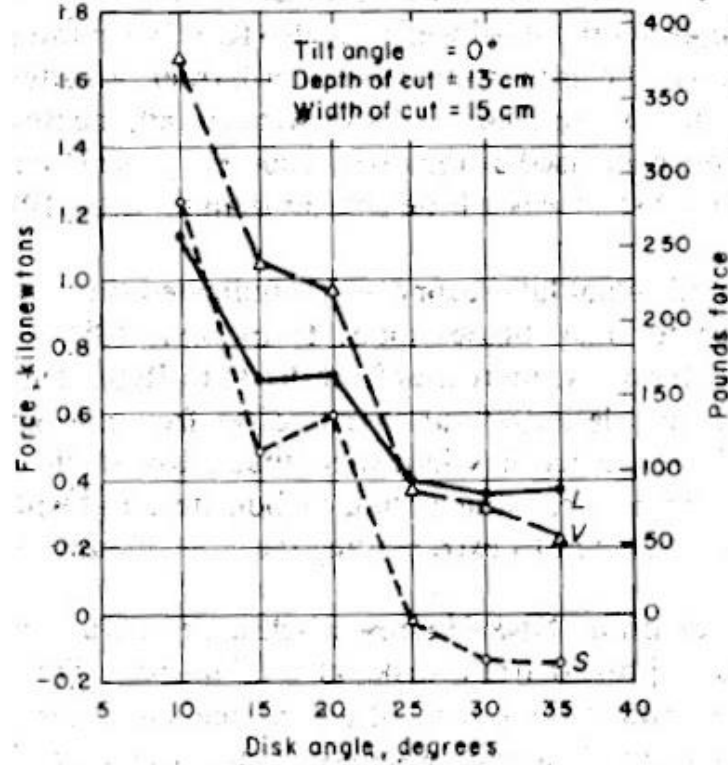
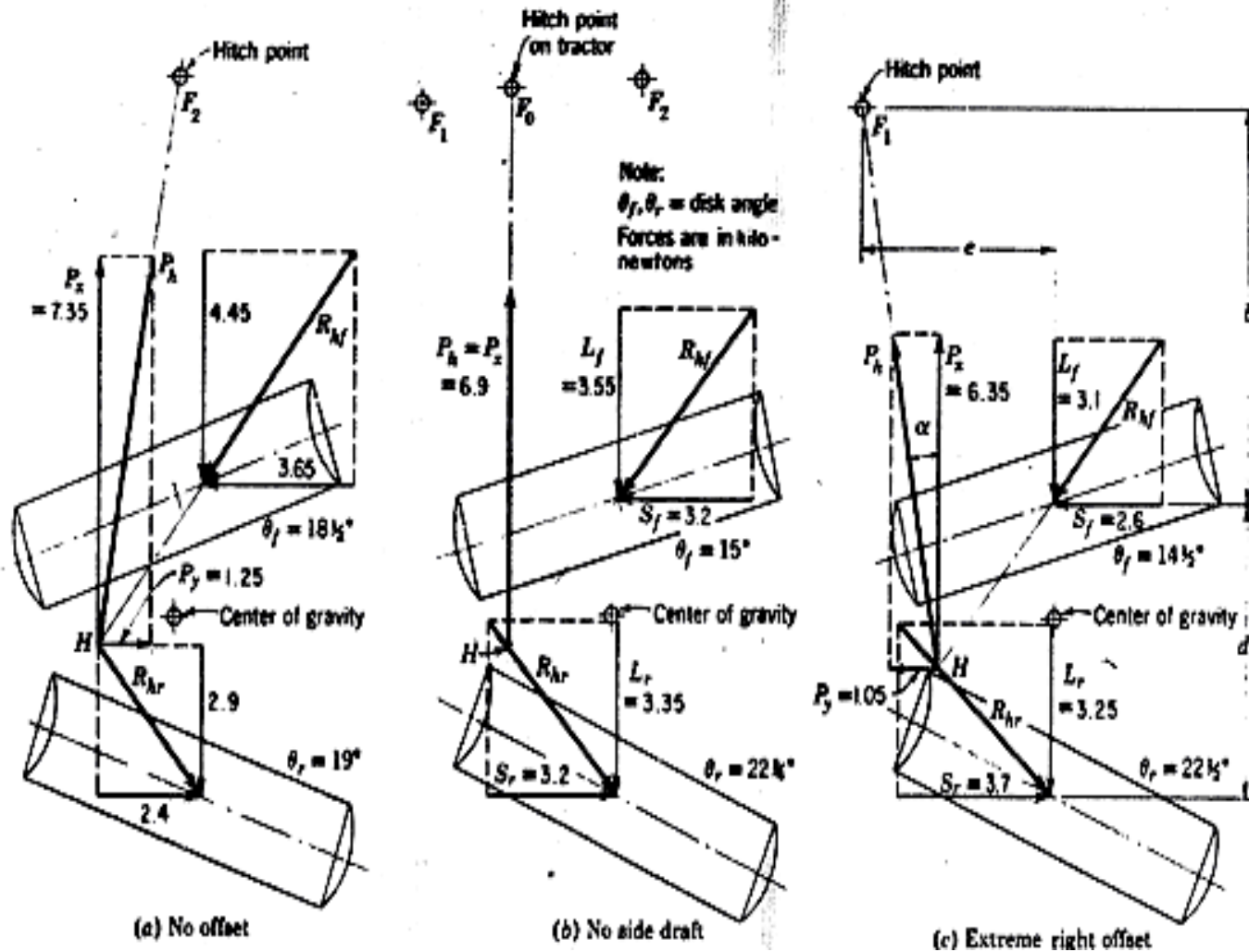


Fig. 5. Effect of disc angle on draft, vertical upward force and side force.

Table 1. Ratios of  $L/V$  and  $S/V$  are given for 46 cm and 56 cm diameter discs

<b>Disc angle, degree</b>	<b>46 cm disc</b>		<b>56 cm disc</b>	
	<b><i>L/V</i> ratio</b>	<b><i>S/V</i> ratio</b>	<b><i>L/V</i> ratio</b>	<b><i>S/V</i> ratio</b>
15	0.5-0.75	0.6-0.9	0.7-0.85	0.15-0.8
19	0.7-1.0	1.0-1.3	0.95-1.1	0.4-1.1
23	0.9-1.2	1.25-1.55	1.3-1.5	1.2-1.4



**Fig. 8 Horizontal force relations for a pull-type, right-hand offset disk harrow without wheels.**

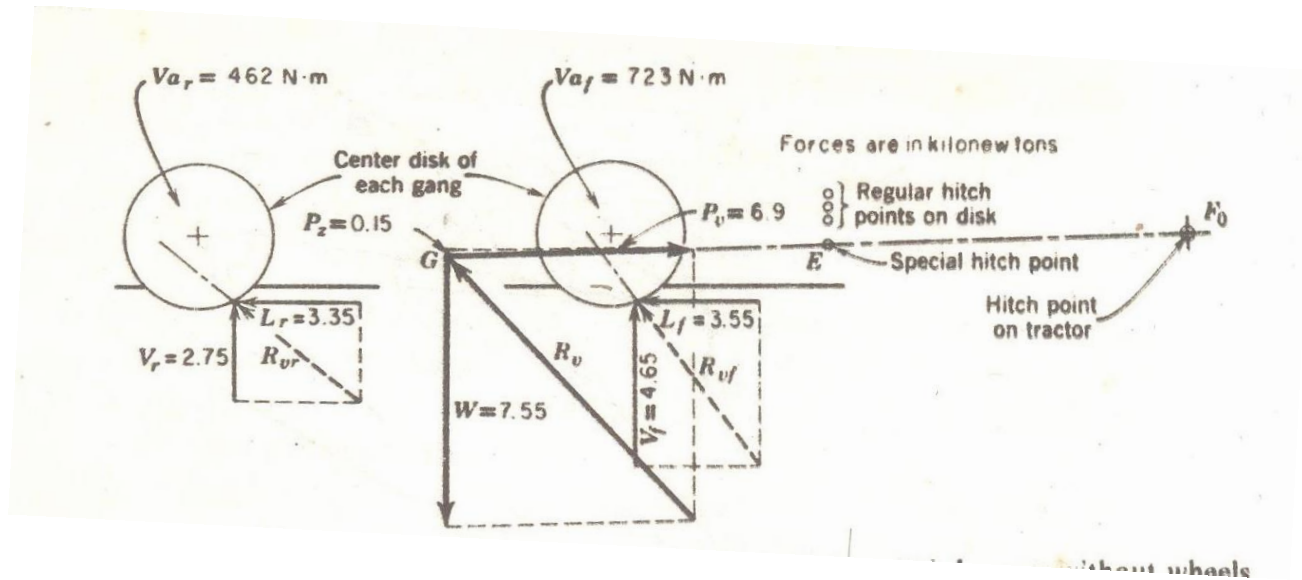


Fig. 9 Vertical force relations for a pull type offset or tandem disk harrow

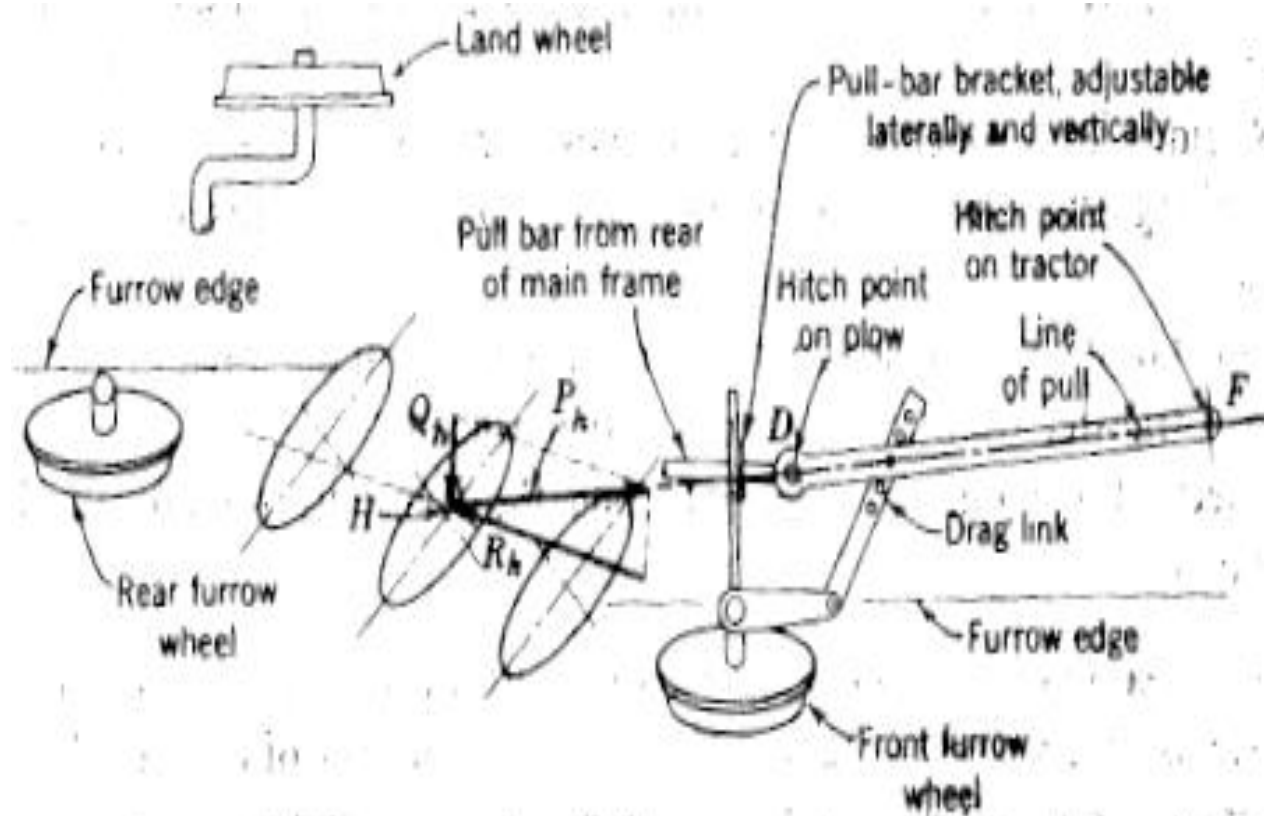
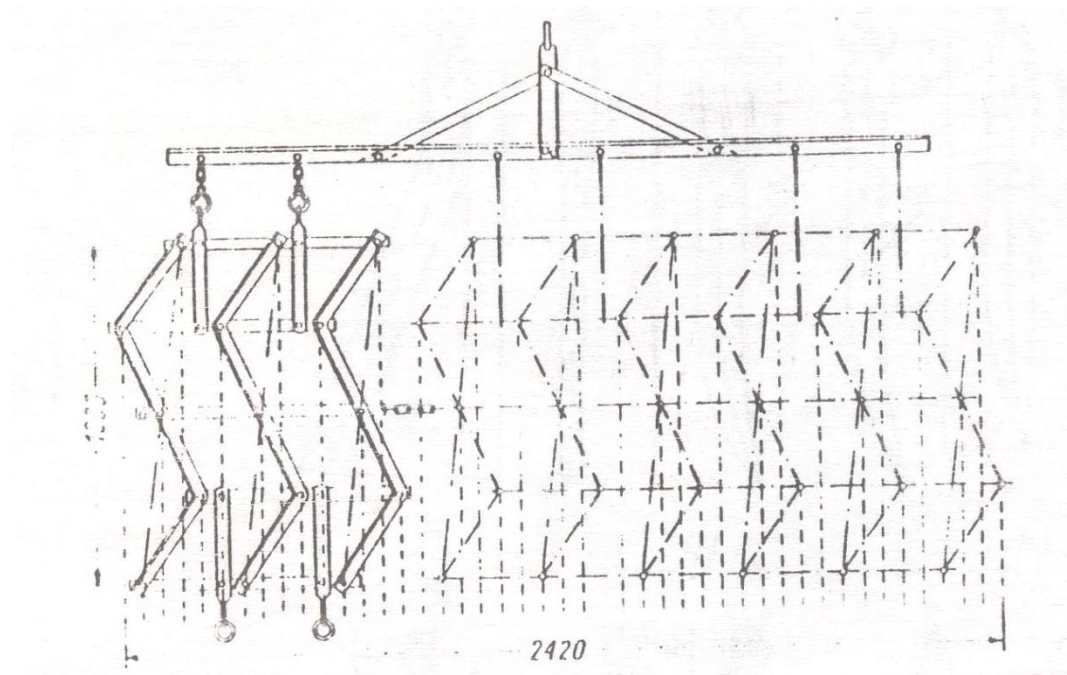
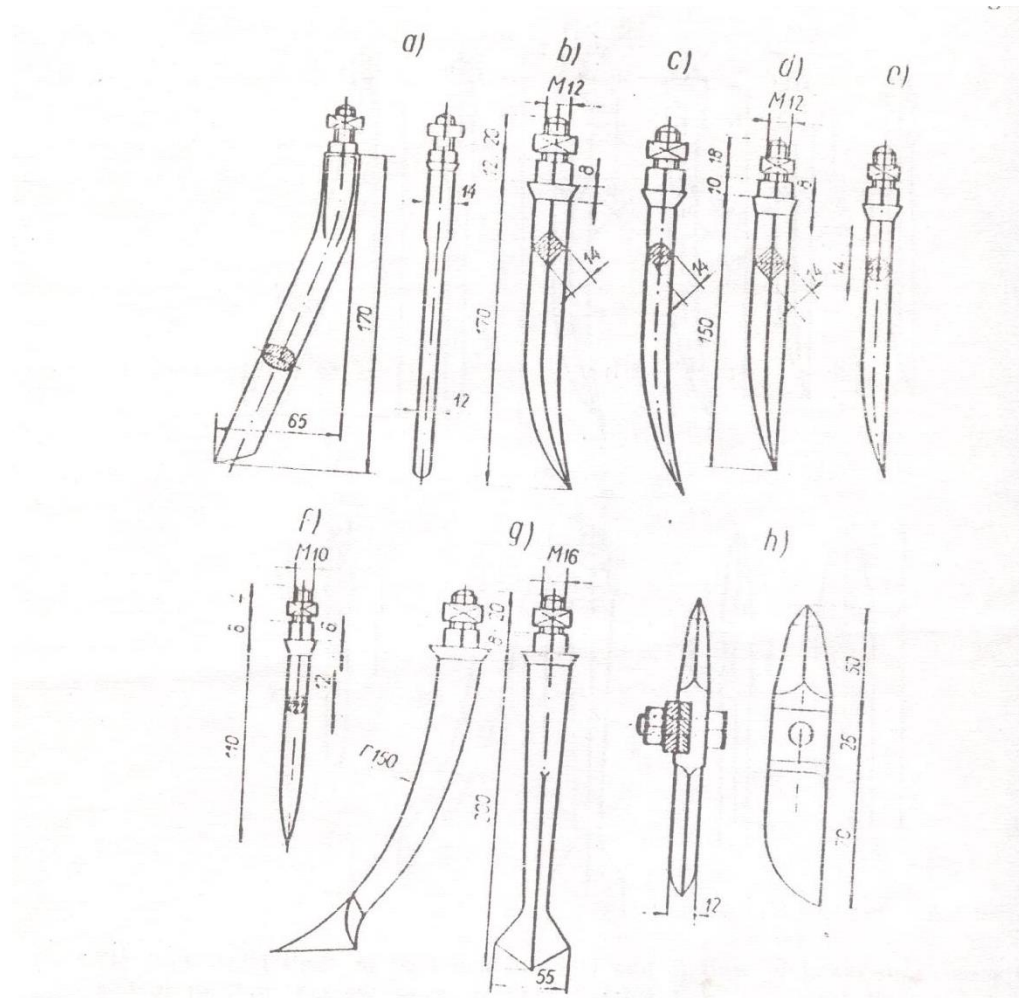


Fig. 10. Horizontal forces acting on pull-type disc plow

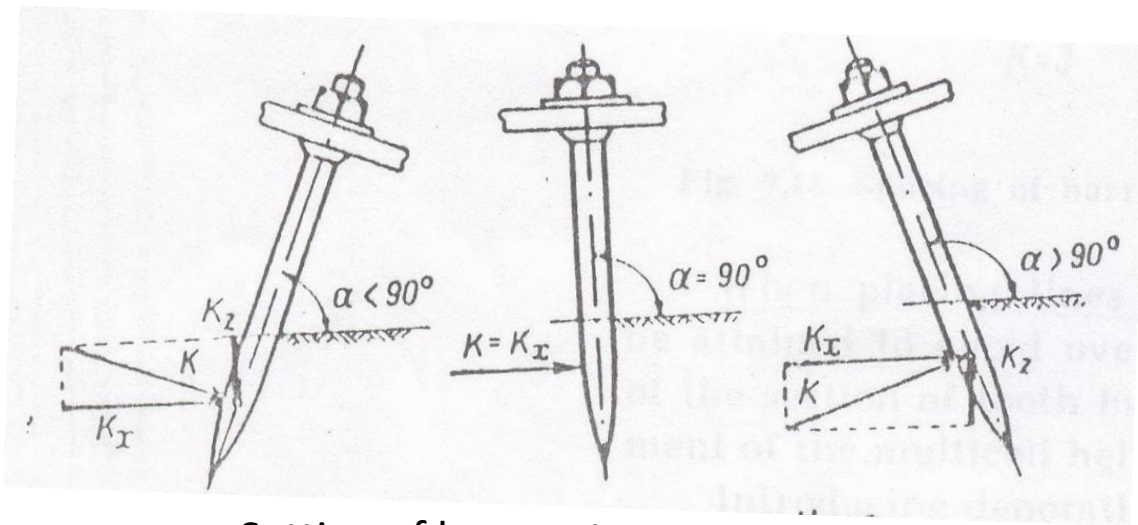


**Three sectional zig-zag harrow**

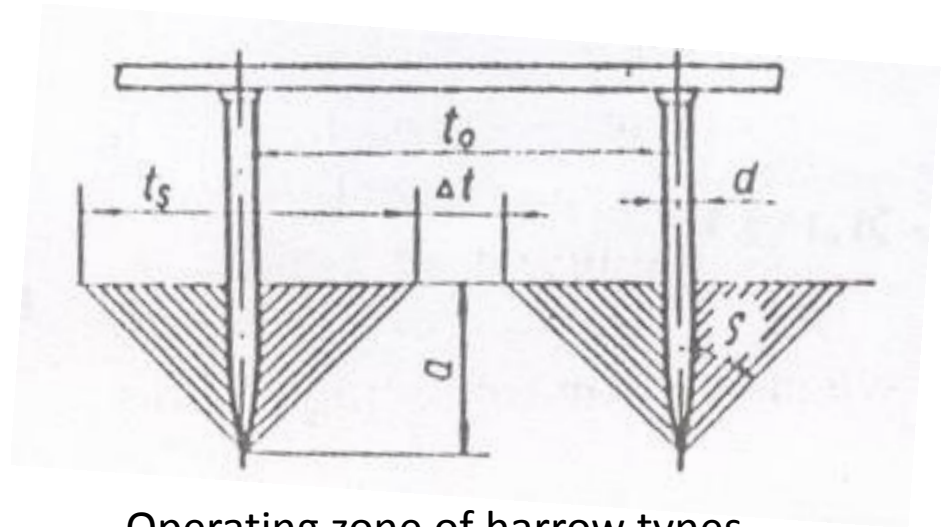


**Rigid tynes : a) bent oval tynes b) and c) tynes of heavy duty harrow d) and e) medium harrow tynes f) Light harrow tyn g) shovel tyn h)Knife of Laacki's harrow.**

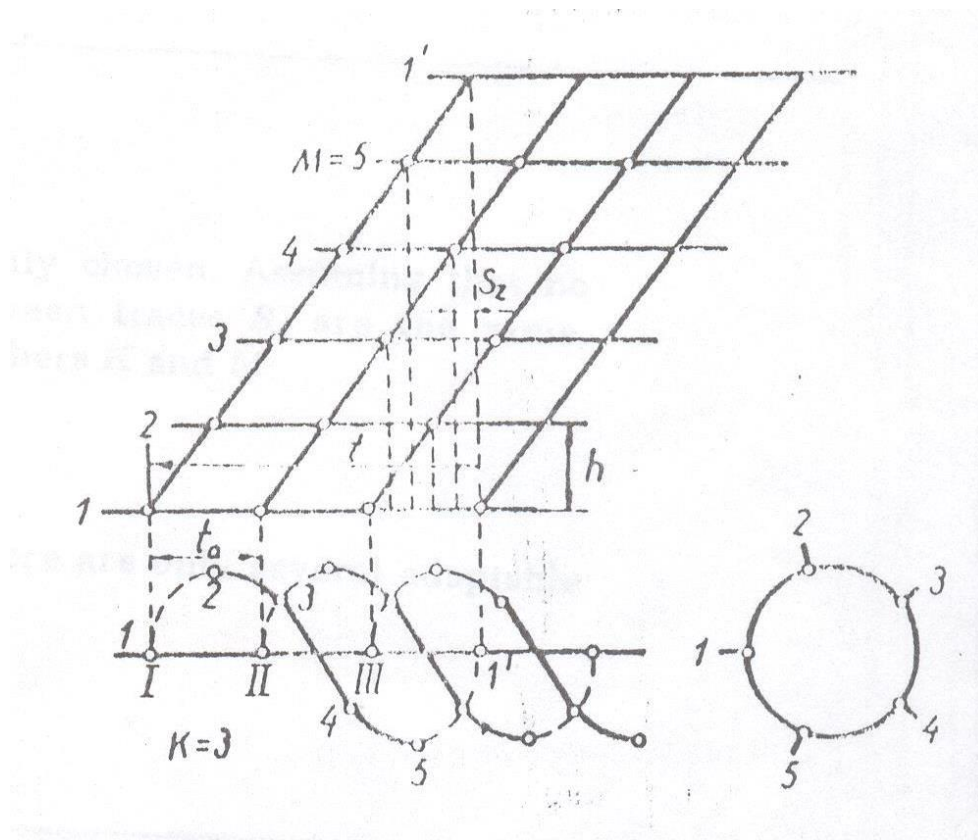




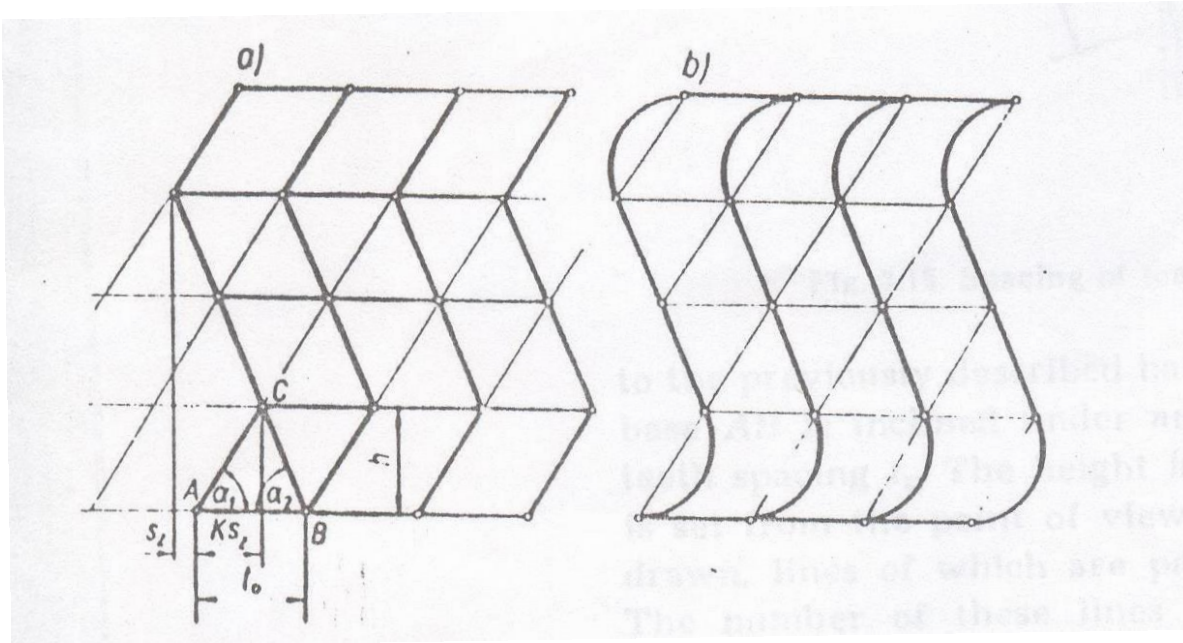
Setting of harrow tynes



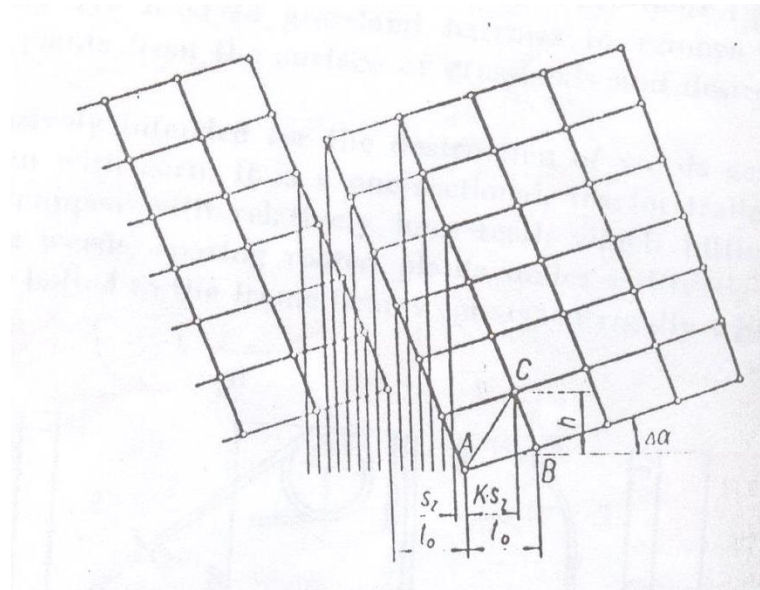
Operating zone of harrow tynes



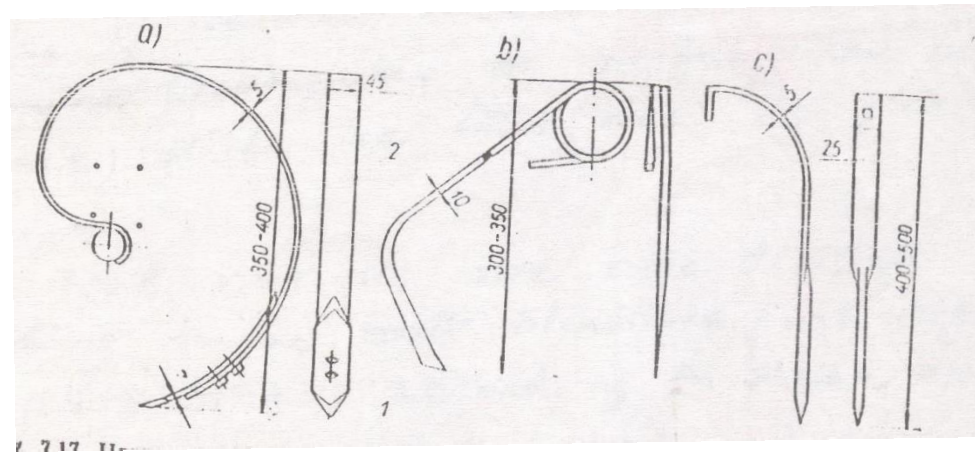
Spacing of harrow tynes



Spacing of teeth in a harrow a) zigzag b) S shaped;  $K = 3$ ,  $M = 5$

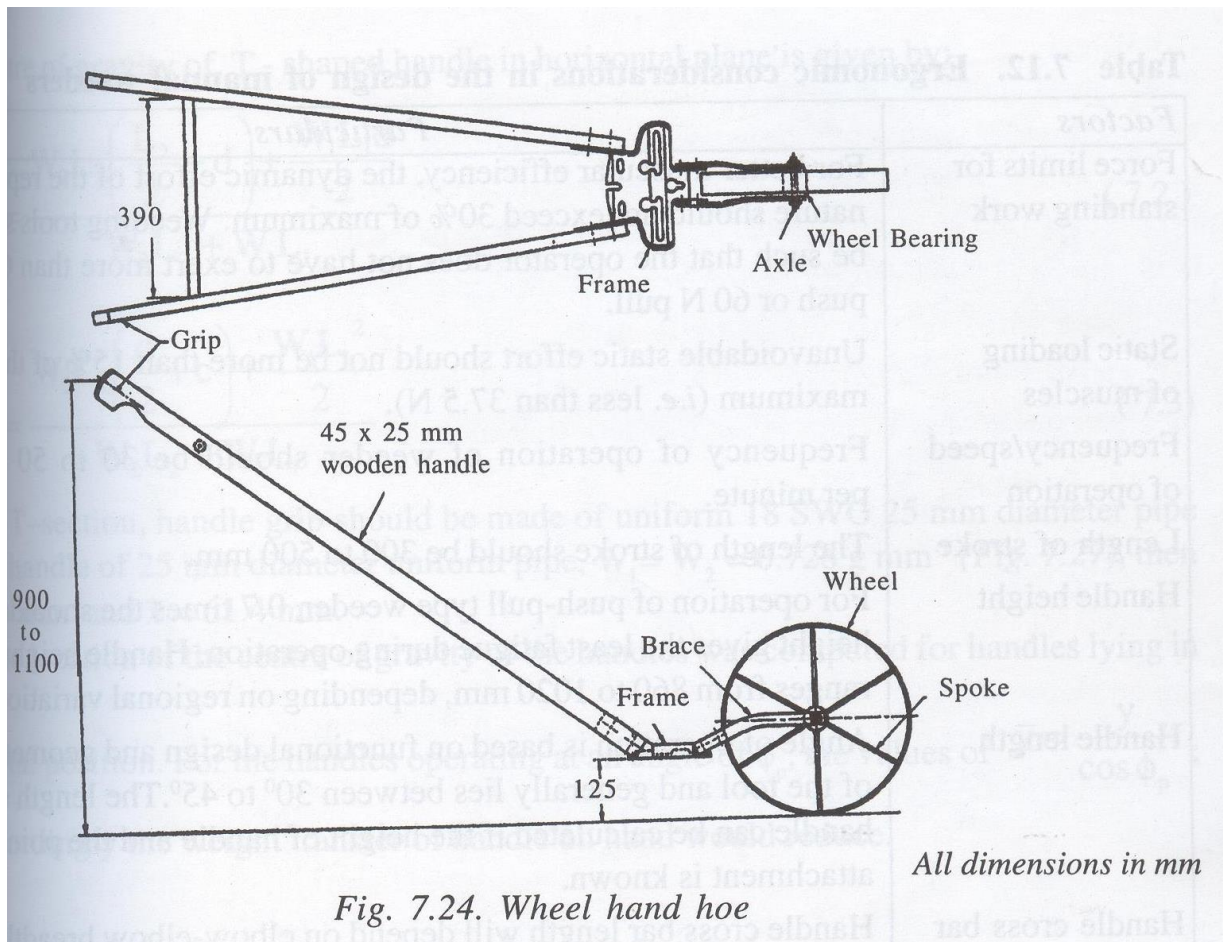


**Spacing of teeth in an oblique harrow:  $K = 5$   $M = 7$**

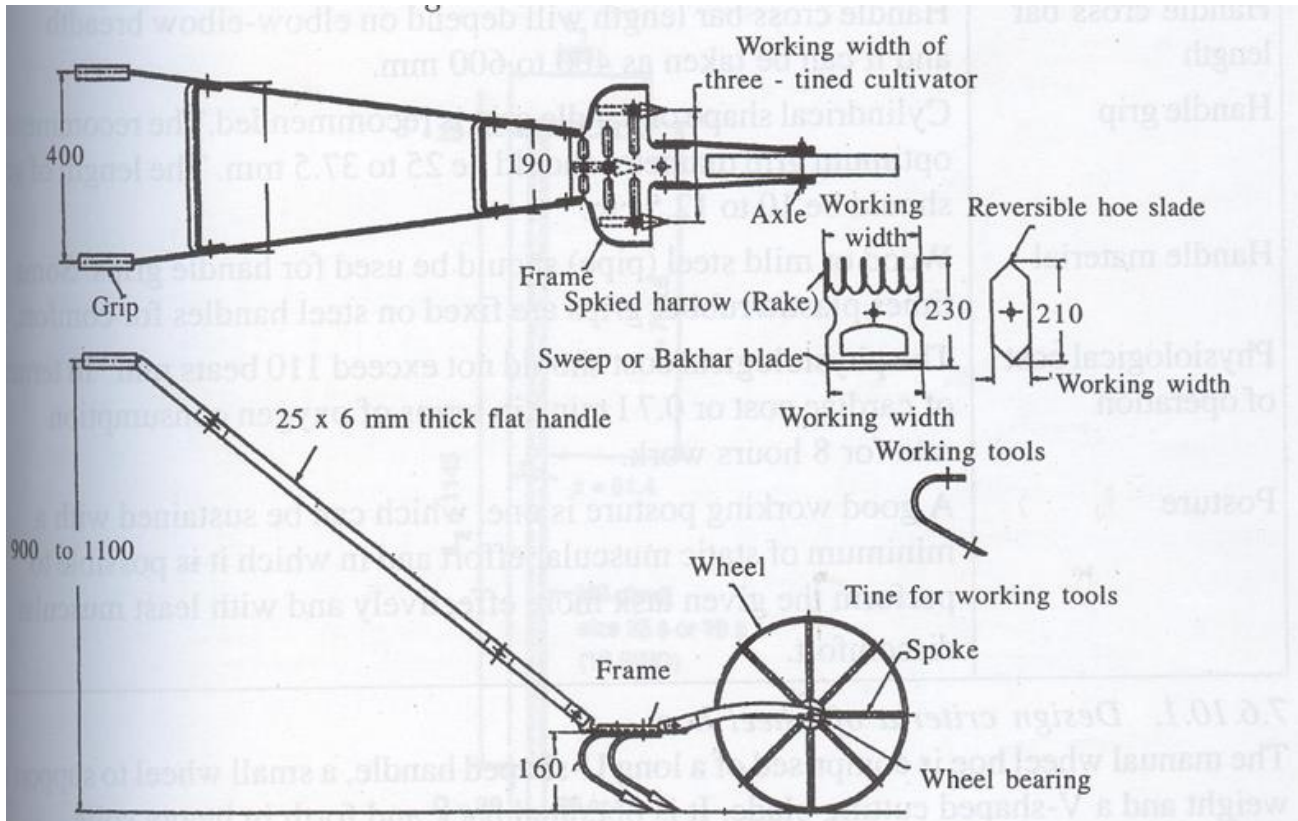


Harrow spring teeth a) tooth of land harrow b) tooth of grassland harrow c) weeder tooth





Weight of the wheel hand hoe should be in the range of 12 to 14 kg.



All dimensions in mm

Fig. 7.25. Wheel hand hoe with different types of working tools

**Table 7.11. Components of wheel hand hoe**

<i>Components</i>	<i>Particulars/Specifications</i>	<i>Materials</i>
Wheel	<p>Diameter of the wheel, mm : 300 to 600</p> <p>Minimum number of spokes in wheel : 8</p> <p>Diameter of each spoke, mm : 6 to 10</p> <p>Wheel rim should be of 35 to 40 mm width and 3 to 4 mm thickness.</p>	Mild steel flat cast iron
Handles	<p>Two steels or wooden members attached to the axle and frame and are used to manoeuvre and control the hoe. The dimensions of the mild steel flat used should be at least 25 x 6 mm.</p> <p>Diameter of the grip, mm : 30 to 40</p> <p>Length of grip should be greater than 125 mm.</p> <p>During operation, the height of the handle grip of the wheel hoe should be 900 to 1100 mm from the ground level.</p>	Wood or mild steel (flat or pipe)
Frame	<p>It is made of single or double rigid cast iron, mild steel angle, flat or mild steel tube structures by welding or riveting. Mild steel flats of 25 to 35 mm width and 3 to 6 mm thickness are used.</p> <p>Working tool, wheel axle and handles are connected to frame.</p>	Cast iron or mild steel (flat or pipe)
Working tools	<p>Working width, mm</p> <p>(a) Spiked harrow (rake) : 200 to 300</p> <p>(b) Reversible hoe blade : 75 to 100</p> <p>(c) Sweep or bakhar blade : 200 to 300</p> <p>(d) Three tined cultivator : 150 to 250</p>	Mild steel of 0.5% C 0.6% C with hardening 350 to 450 HB



**Table 7.12. Ergonomic considerations in the design of manual weeders**

<i>Factors</i>	<i>Particulars</i>
Force limits for standing work	For better muscular efficiency, the dynamic effort of the repetitive nature should not exceed 30% of maximum. Weeding tools should be such that the operator does not have to exert more than 60 N push or 60 N pull.
Static loading of muscles	Unavoidable static effort should not be more than 15% of the maximum ( <i>i.e.</i> less than 37.5 N).
Frequency/speed of operation	Frequency of operation of weeder should be 30 to 50 strokes per minute.
Length of stroke	The length of stroke should be 300 to 500 mm.
Handle height	For operation of push-pull type weeder, 0.7 times the shoulder height gives the least fatigue during operation. Handle height ranges from 860 to 1020 mm, depending on regional variation.
Handle length	Angle of operation is based on functional design and geometry of the tool and generally lies between 30° to 45°. The length of handle can be calculated if the height of handle and the point of attachment is known.
Handle cross bar length	Handle cross bar length will depend on elbow-elbow breadth and it can be taken as 400 to 600 mm.
Handle grip	Cylindrical shape of handle grip is recommended. The recommended optimum grip diameter should be 25 to 37.5 mm. The length of grip should be 10 to 12.5 cm.
Handle material	Wood or mild steel (pipe) should be used for handle grips. Sometimes plastic/rubber grips are fixed on steel handles for comfort.
Physiological cost of operation	The physiological cost should not exceed 110 beats min <sup>-1</sup> in terms of cardiac cost or 0.7 l min <sup>-1</sup> in terms of oxygen consumption rate for 8 hours work.
Posture	A good working posture is one, which can be sustained with a minimum of static muscular effort and in which it is possible to perform the given task more effectively and with least muscular discomfort.

## 6. DIMENSIONS

**6.1** The ground clearance of Type A, Type B and Type C cultivators shall be minimum of 300 mm, 200 mm and 250 mm respectively.

**6.2** The cultivators shall be provided with one or two handles. If two handles are provided, the distance between handle grips shall be between 550 and 650 mm.

**6.3** When the cultivator is set at its working position, the vertical distance between ground and the centre of grip shall be adjustable. The value shall be between 800 and 1 100 mm.

**6.4** The handle grip shall be circular or oval in cross section. The diameter or minor axis shall be between 25 and 35 mm. The length of the grip shall be not less than 125 mm. The angle between the grip and handle shall be between 100 and 105°.

**6.5** The gauge wheel, if fitted, shall be not less than 150 mm in diameter with face width not less than 50 mm.



- 1. Each gang of an offset disk harrow without wheels has 13, 61 cm blades spaced 24 cm apart. The total mass is 1400 kg. In operation  $V_f = 8.7$  kN and  $V_r = 5.3$  kN. The disk angles are  $16^\circ$  for the front gang and  $22^\circ$  for the rear gang. If  $L/V$  is 0.9 for the front gang and 1.2 for the rear gang and the respective  $S/V$  ratio is 0.7 and 1.1. Calculate draft and side draft.**
- 2. A right hand offset disc harrow is operating with disk angles  $15^\circ$  and  $21^\circ$ , respectively for the front and rear gangs. The centers of the two gangs are 2.45 m and 4.5 m behind a transverse line through the hitch point on the tractor drawbar. The horizontal soil force components are  $L_f = 3.1$  kN,  $S_f = 2.65$  kN,  $L_r = 3.35$  kN,  $S_r = 3.8$  kN, Calculate, the horizontal angle of pull from the line of travel, the horizontal pull and amount of offset of the centre of cut with respect to the hitch point**