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HITCHING OF TILLAGE TOOLS



FORCES CONSIDERED IN HITCHING

- INDEPENDENT FORCES
 - L, V AND S OR R_h AND R_v
 - W, GRAVITATIONAL FORCE

- DEPENDENT FORCES
 - PARASITIC FORCE (Q)
 - PULL
 - These forces may be influenced by the hitch system

THE FORCE ANALYSIS IS MOSTLY DONE SEPERATELY IN HORIZONTAL PLANE (R and Q) AND VERTICAL PLANE (P AND W)



THE OBJECTIVE OF HITCHING FOR PULL TYPE IMPLEMENT WITH ADJUSTABLE PULL MEMBER IS:

- TO ESTABLISH THE LOCATION AND MAGNITUDE OF THE RESULTANT PARASITIC FORCES (Q_h OR Q_v) AND PULL (P_h OR P_v)**
- TO FIND OUT THE EFFECTS OF PULLING FORCE ON THE TRACTOR AND THE MAGNITUDE AND DISTRIBUTION OF THE PARASITIC FORCES ON THE IMPLEMENTS**

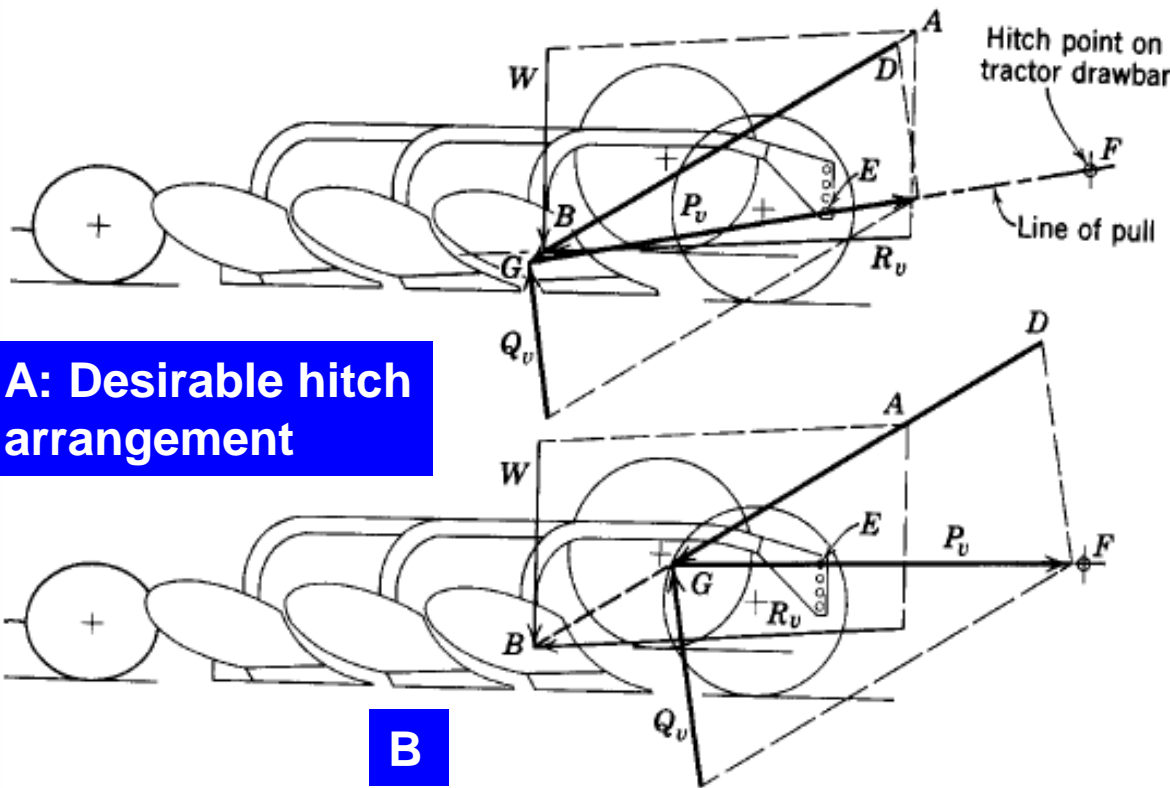
VERTICAL HITCHING SITUATIONS (PULL TYPE IMPLEMENT)

Implement with hinged pull member with support wheels (mb plough, disc plough, drag harrow). The pull member acts as a free link in vertical plane

Implement with hinged pull member without support wheels (disc harrow without wheel, spike tooth harrow). Support is through the soil working parts, parasitic forces can't be separated

SINGLE AXLE IMPLEMENT with rigid pull members (CULTIVATOR, CHISEL PLOUGH, SUBSOILER)

IMPLEMENT WITH HINGED PULL MEMEBERS WITH WHEELS



A: Q_v LOCATED WELL BEHIND FRONT WHEEL

ENOUGH LOAD ON THE REAR WHEEL

STABLE OPERATING CONDITION

B: Q_v UNDER FRONT WHEEL

PRACTICALLY NO LOAD ON THE REAR WHEEL

REAR OF PLOUGH VERY UNSTABLE (WHEN MOMENTARY VARIATION IN R_v)

Hitching at too low a point moves Q_v towards the rear and reduces load on the front wheel

A: Desirable hitch arrangement

B

Figure 8.60 – Vertical force relation for a pull type implement having support wheels and a hinged pull member (reprinted from Kepner et al., 1978).

INCREASING OR DECREASING THE SLOPE OF P_v WITHOUT CHANGING THE LOCATION OF G WOULD DECREASE OR INCREASE Q_v BUT DOES NOT CHANGE ITS LOCATION. More slope of P_v reduce depth of operation with a light implement.

IDEAL HITCH POINT IN MB PLOUGH: P_v PASSES THROUGH A POINT BELOW THE GROUND SURFACE AND DIRECTLY ABOVE THE AVERAGE LOCATION OF ALL SHARE POINTS.

IDEAL HITCH POINT FOR THE DISC PLOUGH: P_v PASSES AT THE GROUND SURFACE MIDWAY BETWEEN THE CENTRE OF THE FRONT AND REAR DISC

IMPLEMENT WITH HINGED PULL MEMEBERS WITHOUT WHEELS

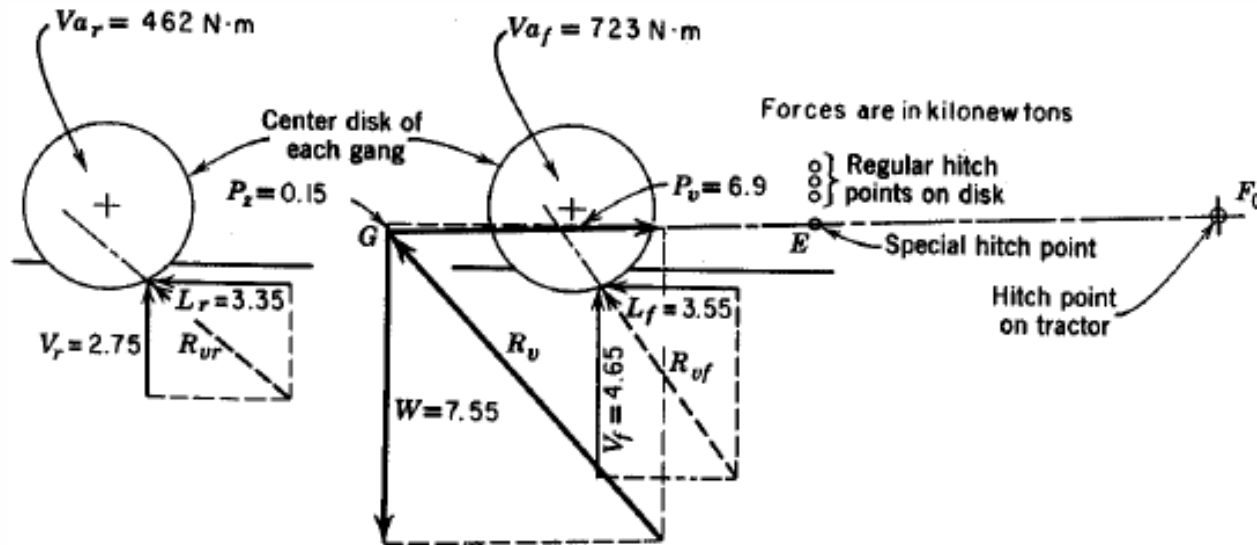


Figure 8.61 – Vertical force relation for a pull type offset or tandem disk harrow without wheels and no hinge axis between the front and the rear gangs (reprinted from Kepner et al., 1978).

THE R_{vf} & R_{vr} ADJUST THE DEPTH SO THAT THE RESULTANT R_v PASSES THROUGH G .

RAISING THE HITCH POINT OF THE IMPLEMENT RAISES 'G' AND MOVES R_v CLOSER TO THE FRONT GANG RESULTING AN INCREASE IN R_{vf} AND DECREASE IN R_{vr}

THIS INCREASES THE DEPTH IN FRONT AND DECREASES IN THE REAR GANG.

R_{vf} MORE THAN R_{vr} BECAUSE FRONT GANG OPERATES IN HARD SOIL

SINGLE AXLED IMPLEMENTS WITH RIGID PULL MEMBER WITH WHEELS

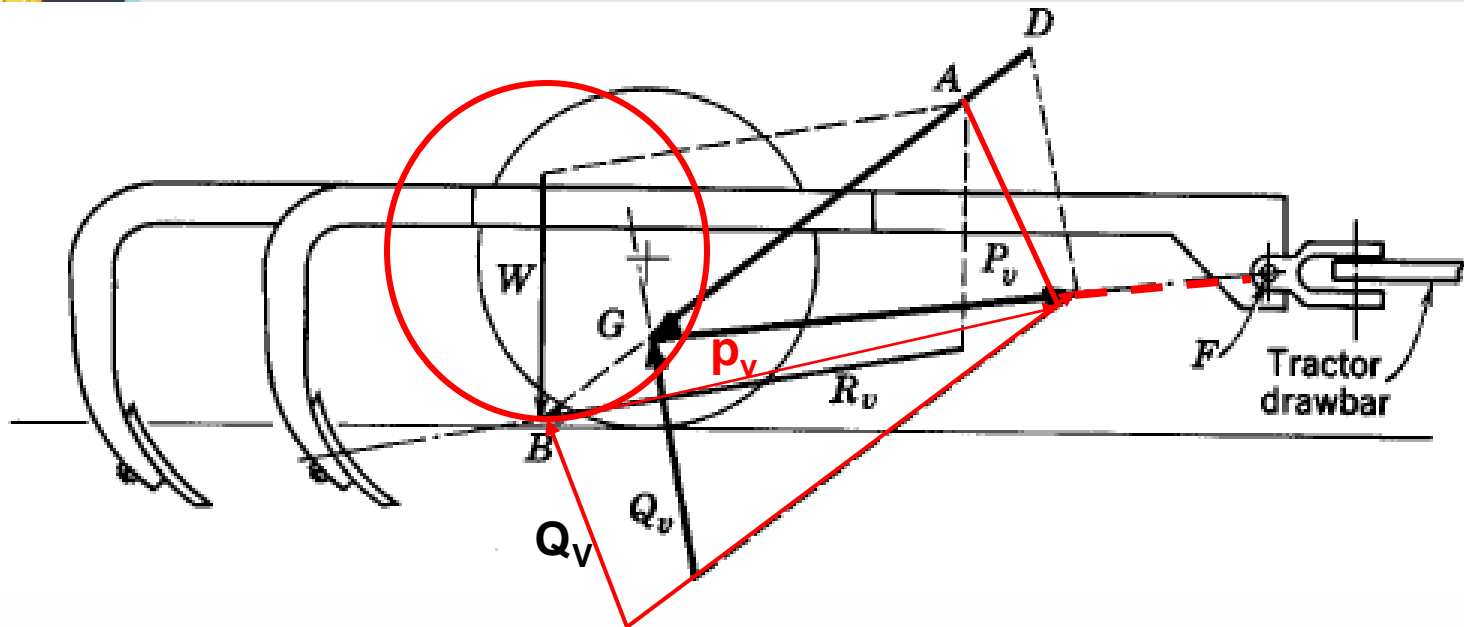


Figure 8.62 – Vertical force relations for a single-axle, pull-type implement receiving vertical support only through its wheels (reprinted from Kepner et al., 1978).

LOCATION OF Q_v FIXED AND PASSES SLIGHTLY BEHIND THE CENTRE OF THE AXLE TO PROVIDE TORQUE.

ONLY POSSIBLE HITCH ADJUSTMENT IS CHANGING THE HEIGHT OF THE DRAWBAR AT F WHICH WOULD CHANGE THE SLOPE OF P_v .

IF WHEEL MOVED REAR W.R.T THE TYNES, SLOPE OF P_v INCREASES AND Q_v DECREASES



HORIZONTAL HITCHING OF THE PULL TYPE IMPLEMENTS

MOST TILLAGE IMPLEMENTS ARE SYMMETRICAL ABOUT LONGITUDINAL CENTRE LINE EXCEPT MB PLOUGH, DISC PLOUGH AND OFFSET DISC HARROW

SIDE COMPONENTS OF SOIL FORCES NEEDS TO BE BALANCED

HORIZONTAL CENTRE OF RESISTANCE IS AT THE CENTRE OF THE TILLED WIDTH

HORIZONTAL LINE OF PULL IS IN DIRECTION OF TRAVEL

- **PLOUGHS AND OFFSET DISC HARROWS ENCOUNTER HUGE SIDE DRAFT, HENCE PROPER HITCHING IS NECESSARY**
- **MB PLOUGH ABSORBS SIDE DRAFT THROUGH LANDSIDE**
- **DISC PLOUGH THROUGH FURROW WHEEL**
- **OFFSET DISC HARROW BY CHANGING GANG ANGLE**



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HORIZONTAL CENTRE OF RESISTANCE BEHIND THE CENTRE OF PULL DIFFICULT IN NARROW IMPLEMENTS AND WIDE TREAD

IF IMPLEMENT CAN WITHSTAND SIDE FORCES THE ALTERNATIVES ARE

CENTRAL ANGLED PULL PASSING THROUGH THE CENTRE OF THE PULL OF TRACTOR

OFFSET STRAIGHT PULL (the force analysis of offset disc harrow)

OFFSET ANGLED PULL

IF IMPLEMENT CANNOT WITHSTAND SIDE FORCES

OFFSET STRAIGHT PULL

CENTRE OF PULL OF THE TRACTOR IS GENERALLY AT THE MIDWAY BETWEEN THE REAR WHEELS AND SLIGHTLY AHEAD OF THE AXLE

CENTRAL ANGLED PULL DOES NOT AFFECT TRACTOR STEERING BUT AN OFFSET PULL DOES. BUT AN ANGLED PULL EITHER CENTRAL OR OFFSET INTRODUCES A SIDE FORCE ON THE TRACTOR REAR WHEELS.



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HITCH FOR MOUNTED IMPLEMENT

TWO TYPES OF HITCHES

**3-POINT HITCH FOR REAR MOUNTED
IMPLEMENTS**

**PARALLEL –LINK HITCH FOR FRONT MOUNTED
IMPLEMENTS**

• **DESIGN CONSIDERATION OF 3-POINT HITCH**

- **EASE OF ATTACHMENT AND ADJUSTMENT, VERSATILITY AND SAFETY**
- **STANDARDIZATION TO PERMIT INTERCHANGEABILITY**
- **UNIFORMITY OF TILLAGE DEPTH**
- **ABILITY TO OBTAIN PENETRATION OF THE IMPLEMENT**
- **RAPIDITY WITH WHICH TOOLS LIKE PLOUGHS & LISTER ENTER THE GROUND**
- **TRAILING CHARACTERISTICS OF THE IMPLEMENT AROUND CONTOUR AND ON SIDE HILL**
- **EFFECT OF IMPLEMENT ON TRACTIVE ABILITY OF THE TRACTOR**
- **EFFECT OF RAISED IMPLEMENT ON TRANSPORT STABILITY OF TRACTOR**

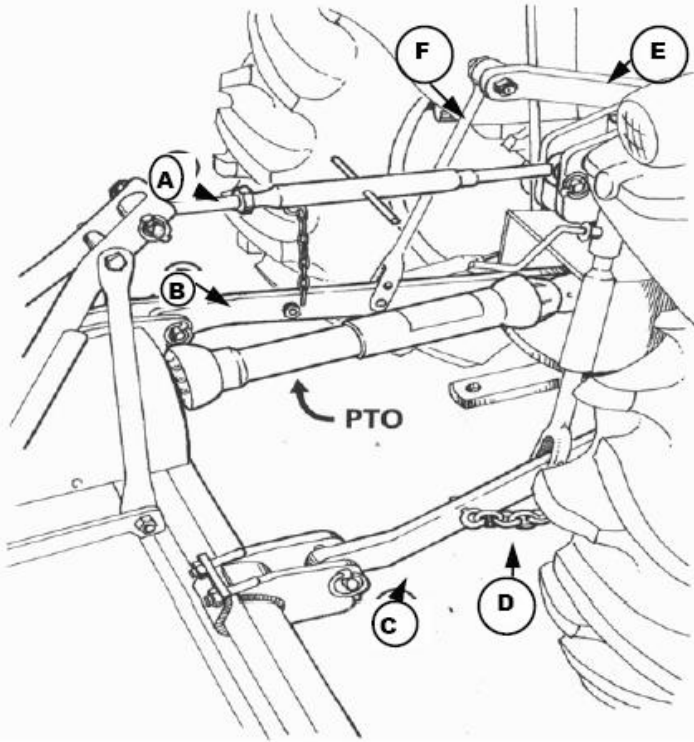
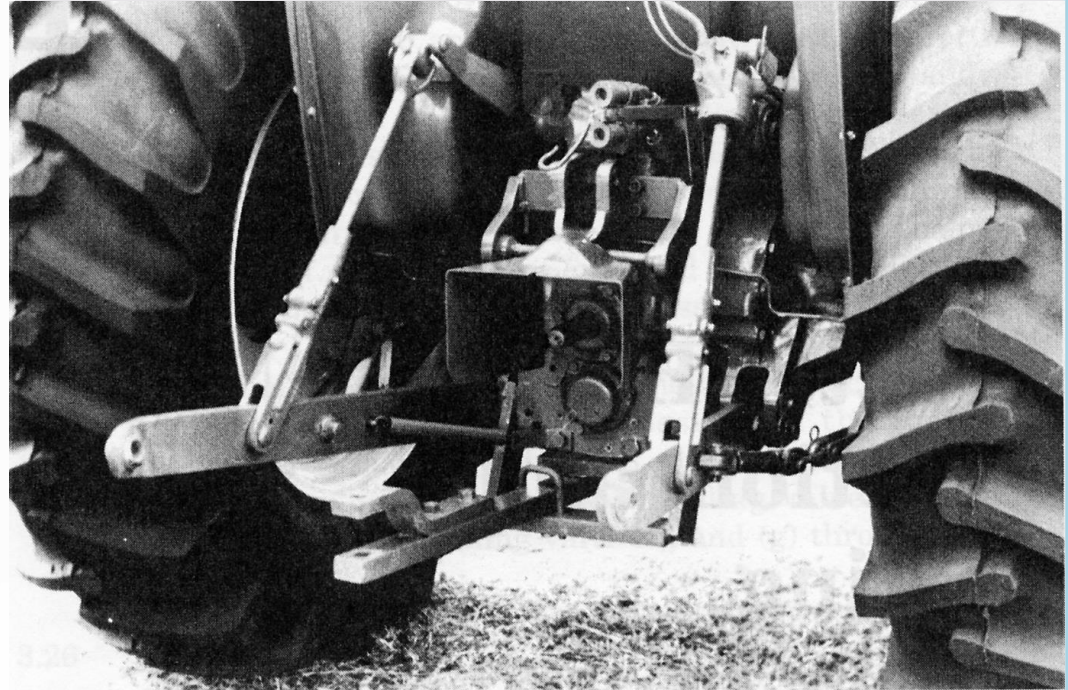


Figure 5.1.f. Parts of the 3-Point Hitch

- A. Upper Link
- B,C. Draft Arms
- D. Anti-sway bar or chain
- E. Lift Arm
- F. Lift Rod



THREE POINT HITCH LINKS IN A TRACTOR