

KES

Design Standard for Clutch of Special Equipped Car

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1. Scope of Application

This standard shall prescribe the design for clutch of a special equipped car which equipment is clutched to the chassis of a truck of 1 ~ 5 ton.

2. Purpose

The purpose of this standard is to design of a special equipped car suited to the standard for special needs of customers, to investigate the technical item required in case of clutching them to a basic car and chassis and refer it

3. Meaning of Terminology

- (1) Special equipped car : It is a car with a special equipment, which is attached to a basic car and driven with the power device of a basic car itself or separate power device loaded in a basic car.
- (2) Special utility car : It is a car with a special body and equipment for special purpose.
- (3) Special car : It is a car with a special structure, or machine for a special work operated separately.
- (4) P.T.O (Device for taking off power) : Abbreviated name of Power Take Off : T/M P.T.O, T/F P.T.O, F/W P.T.O etc.

4. Data for Design

Basic idea book for clutching a special equipped car of the M. C Titan and Boxer

5. Design Procedure (Investigation sequence)

5.1 Power take off for driving a special equipped car (P.T.O)⁽¹⁾

Because driving power for clutching equipment is almost supplied with a engine of a

basic car, the next items have to be investigated.

- (1) How much torque is required for power take off?
- (2) What kind of P.T.O is recommended per torque?

Note⁽¹⁾ : P.T.O is an abbreviated name of Power Take Off and divided into the next 4 kinds as per purpose for use.

T/M P.T.O, T/F P.T.O, F/W P.T.O, Front Drive P.T.O

5.2 Engine

- (1) When a crane, concrete pump, vacuum car, LPG tank lorry and so on are clutched to a truck, and its driving power is taken off from the engine of a basic car, rpm of an engine has to be unchanged.
- (2) If the governor of an injection pump is an all speed governor, no problem is raised. But in case of a min max type governor, because of its irregular revolution, it has to be exchanged for an all speed governor.
- (3) The performance of an basic car and special equipped car engine can be changed by the relation with the administration(Ministry of transportation, environmental protection agency)

Table 1.

Engine type	Applicable	Performance		Remark
		Max R.P.M	Max HP	
SL	NT-0	3400	105	
SL-1	Special equipped NT-0 NT-1	3100	105	
SL-2	NT-1	3200	105	

5.3 Drive shaft (Propeller shaft)

- (1) Attachment angle : When a center B.R.G is fixed at the center point, the relative angle of a front joint is less than 4° for up & down direction, and less than the real angle of

3° 30' for up & down and left & right directions.

And the relative angle of a center B.R.G side joint is less than 10° .

(2) Risk speed

$$n = \frac{60\pi}{2\ell^2} \sqrt{\frac{E \cdot I \cdot g}{A \cdot r}} \dots\dots\dots (1)$$

ℓ : Length of axle mm (Distance between "+" Shaped axles)

A : Sectional area of axle mm²

I : 2nd moment of axle mm⁴ = $\frac{\pi}{64} (d^4 - d_1^4)$ mm⁴

E : Young's modulus kg / mm² (21000 kg / mm²)

r : Specific gravity weight kg / mm³ (7.85×10^{-6} kg / mm³)

g : Acceleration of gravity mm / S² (9800 mm / S²)

The safety ratio of risk speed is more than 1.5.

Remark : (1) For a tool, a pipe with regulated material and dimension have to be used.

(2) For a welding part of a shaft, the auto carbon acid gas welding of more than 80 % is used and the sure control of arc voltage and current welding speed is required.

(3) To keep a shaft weight balance, make the maximum shaft vibration less than 0.5 mm.

5.4 Steering

Calculation of the minimum rotation radius (R)

$$R = \frac{\frac{L}{\sin \beta} + \sqrt{L^2 + (L \cos \alpha + K)^2}}{2} + d \dots\dots\dots (2)$$

α = Inner circle angle

β = Outer circle angle

L = Distance between axles

K = Distance of kingpin

d = Distance from the center of a wheel contact surface and kingpin

5.5 Brake pipe

- (1) Because a brake hose is an important compensational part, the failure with contact must be prohibited.
- (2) The change of pipe laying is not recommended.
- (3) If the change of a brake is inevitable, carry out with the attention to the next items.
 - (a) A zinc-galvanizing steel pipe is used as a brake pipe.
 - (b) Set up a brake at no heat effective area.
 - (c) The bending of a pipe(R) is carried out with more than 20R and any damage on a pipe surface is not allowed.
 - (d) When bending a pipe, do not make a pipe flat.
 - (e) The gap of a clip is less than 350mm.
- (4) For a vacuum car, tank lorry, garbage truck and so on that have large danger of rusting, the counterplan for anti-rust is required.

5.6 Tire

Refer to the notice item at the standard of compensation (7-3, 7-4, 7-5).

5.7 Investigation item for clutch of a special equipped car

- (1) Make a rear body light.

If a rear body is light, more inertia is acquired. On the other hand, if the weight is large, a basic body is weak.

- (2) For a rear body, decrease concentrative load and increase distributive load.

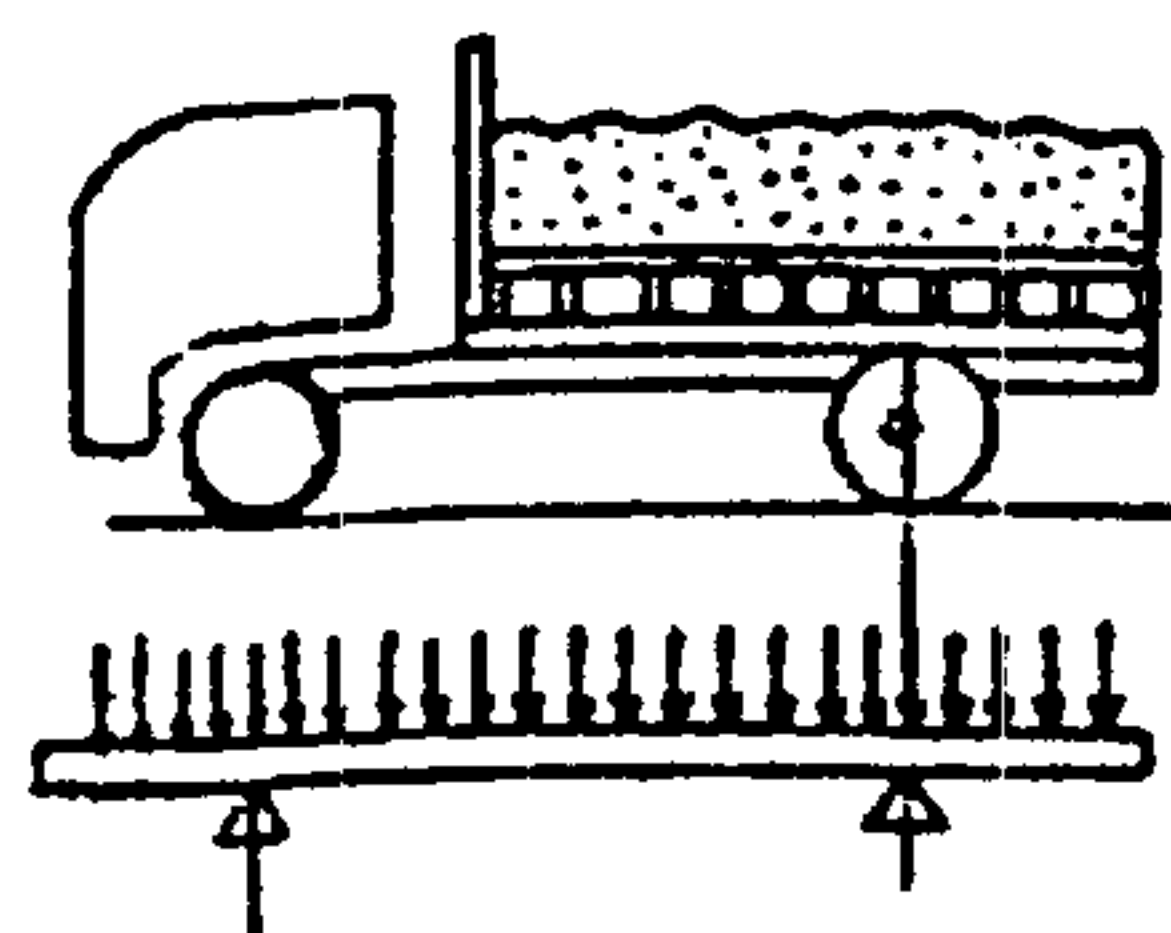


Fig. 1 : Distributive load

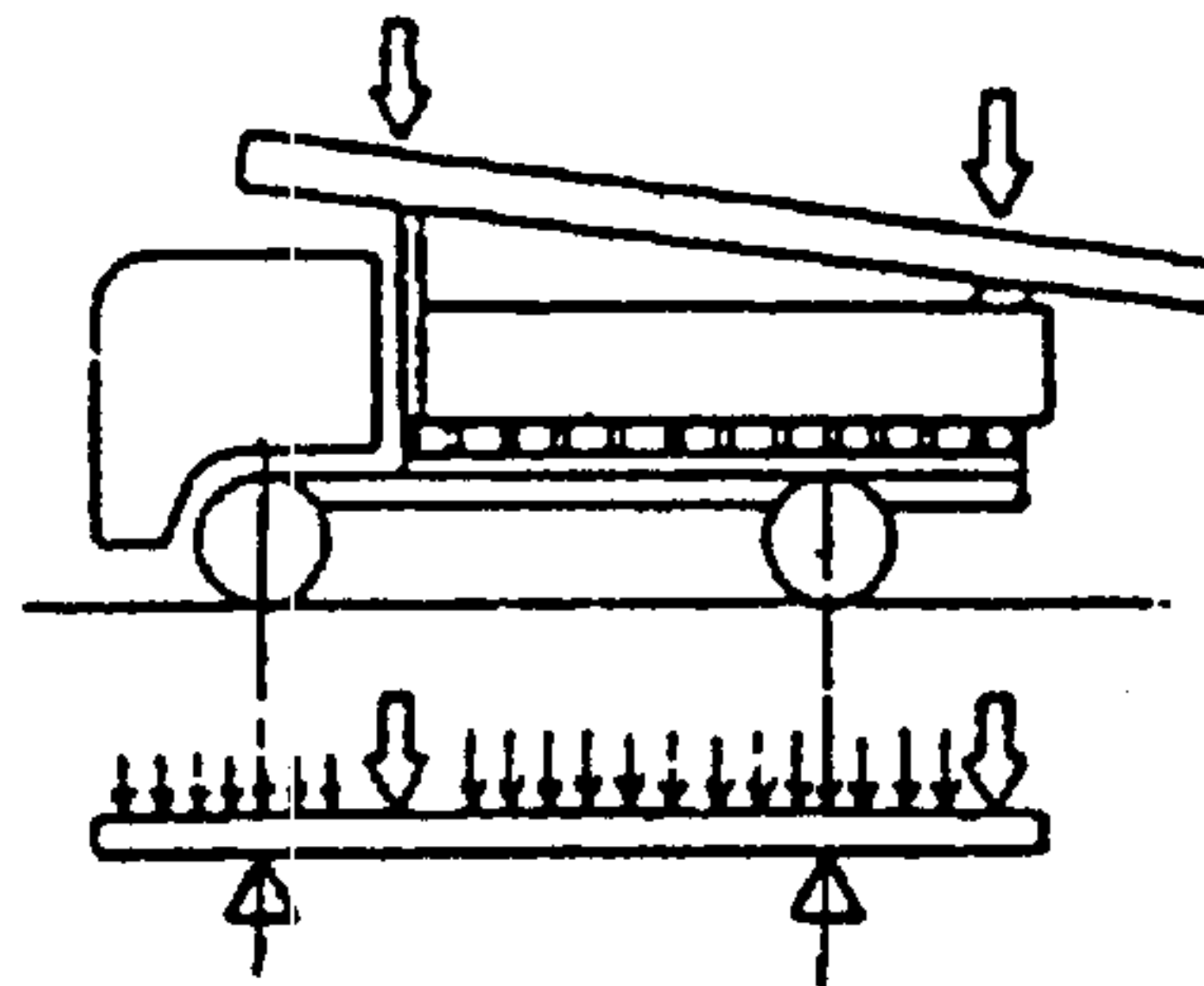


Fig. 2 : Concentrative load

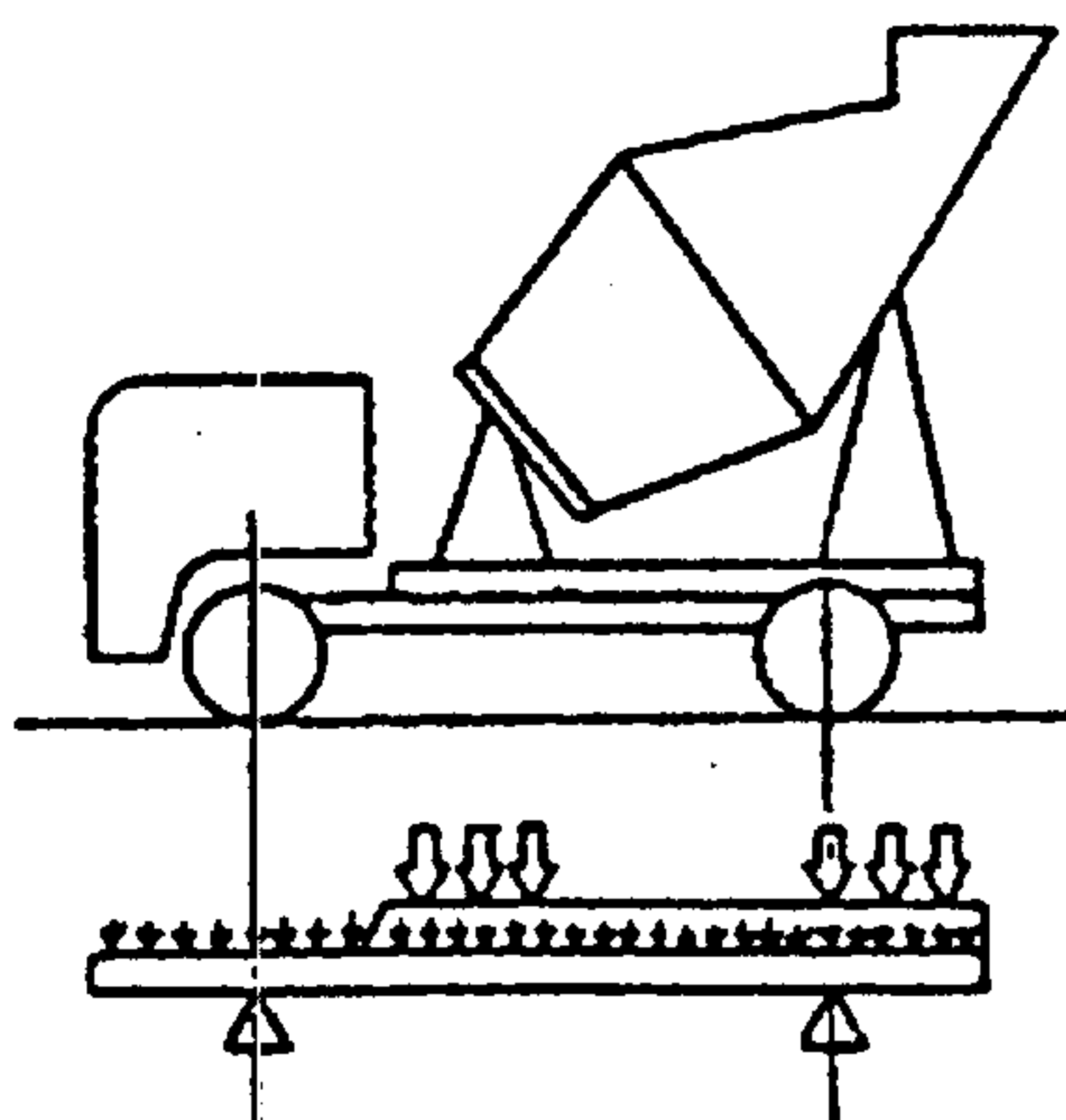
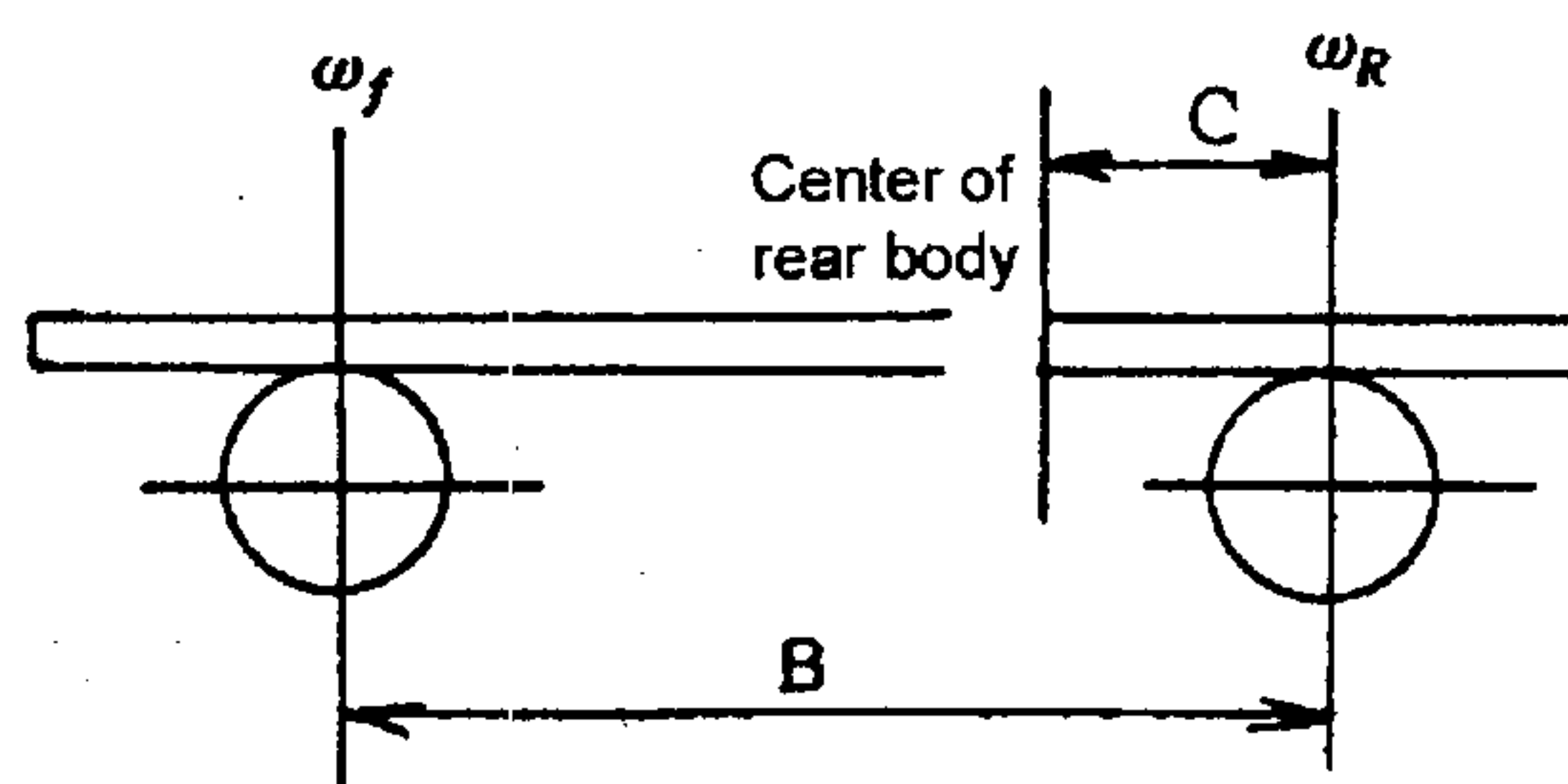


Fig. 3 : Partial load

(3) Calculate the load of a front and rear wheel.

To satisfy all conditions with the next equation of compensational standard, investigation must be carried out.



ω = Total weight of a car (kg)

ω_f : Load of a front wheel (kg)

ω_R : Load of a rear wheel (kg)

C : Off set

B : W / Base

N_f : Number of front tires

N_R : Number of rear tires

K : Maximum recommended load of a tire

$$\left\{ \begin{array}{l} \omega = \omega_f + \omega_R < 20 \text{ Ton} \\ \frac{\omega C}{B} = \omega_R < 10 \text{ Ton} \\ \omega - \omega_R = \omega_f < 10 \text{ Ton} \end{array} \right.$$

$$\frac{\omega_f}{\omega} \times 100 > 20 \%$$

$$\frac{\omega_f}{N_f \times K} \times 100 < 100 \%$$

$$\frac{\omega_R}{N_R \times K} \times 100 < 100 \%$$

(a) Equation for the weight of the 2nd axle (Fig 4.)

$$W_f = \omega_f + \frac{a_1 P_1 + a_2 P_2 + a_3 P_3 + a_4 P_4 + \dots}{L}$$

$$W_r = W - W_f$$

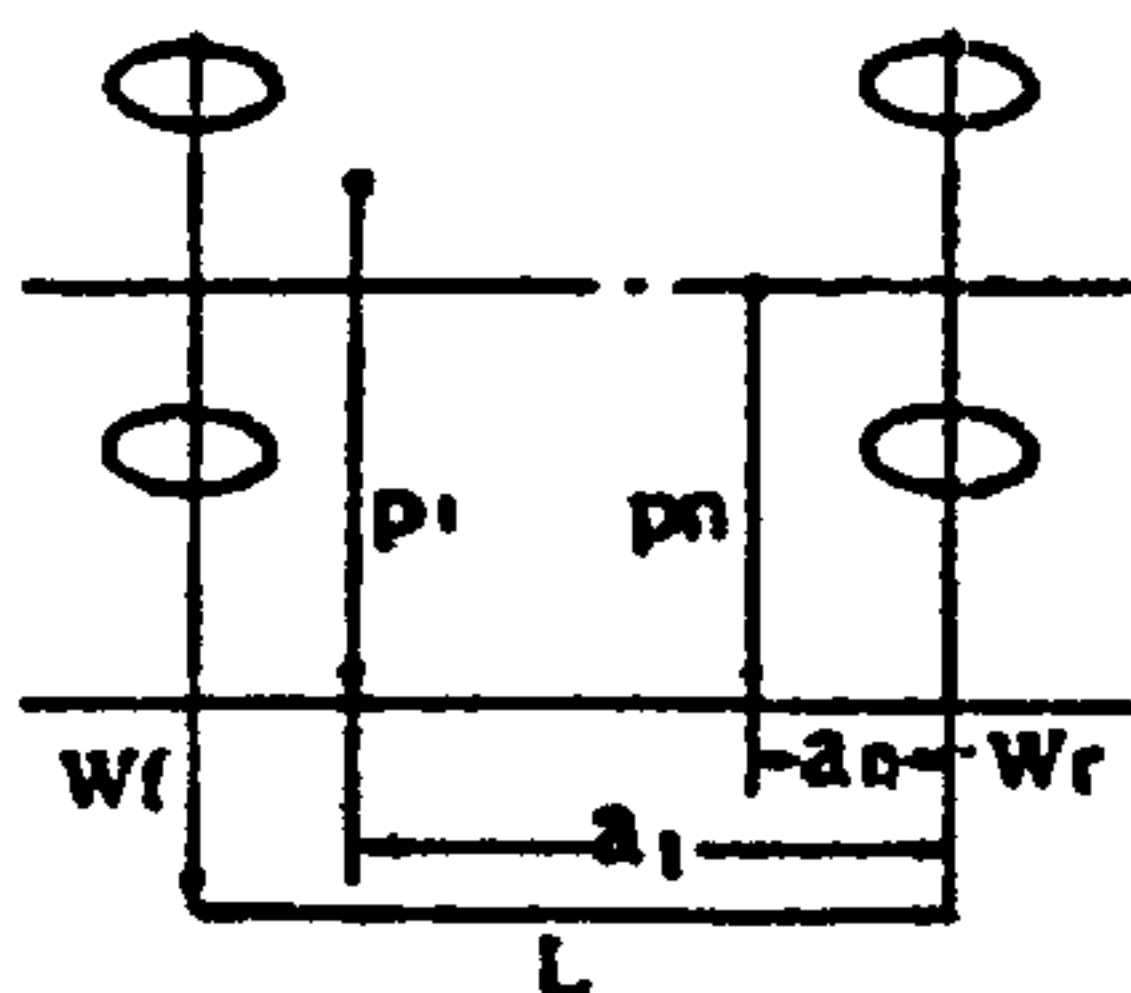


Fig 4. : One axle of a front and rear wheel

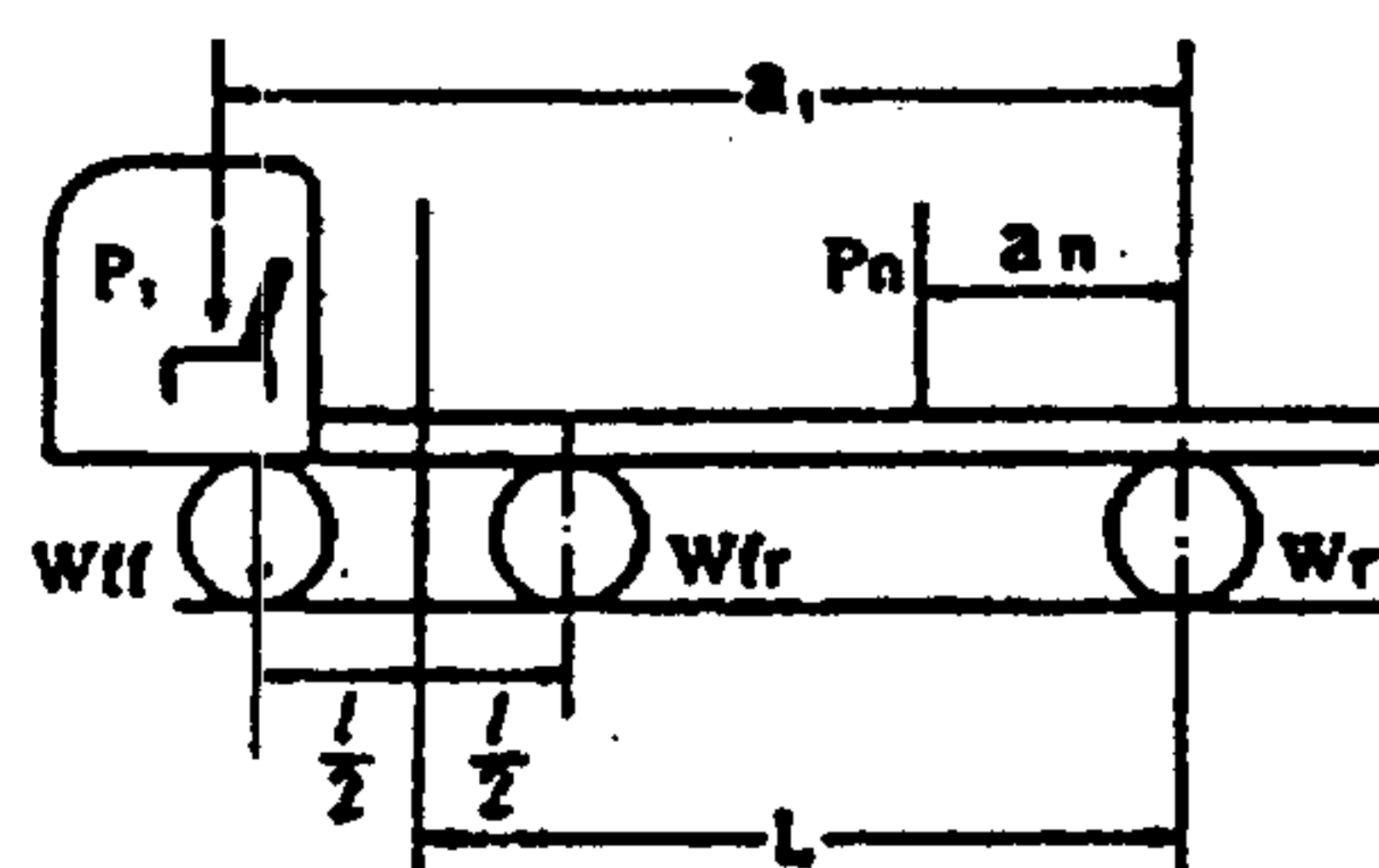


Fig 5. : Two axles of front wheels and one axle of a rear wheel

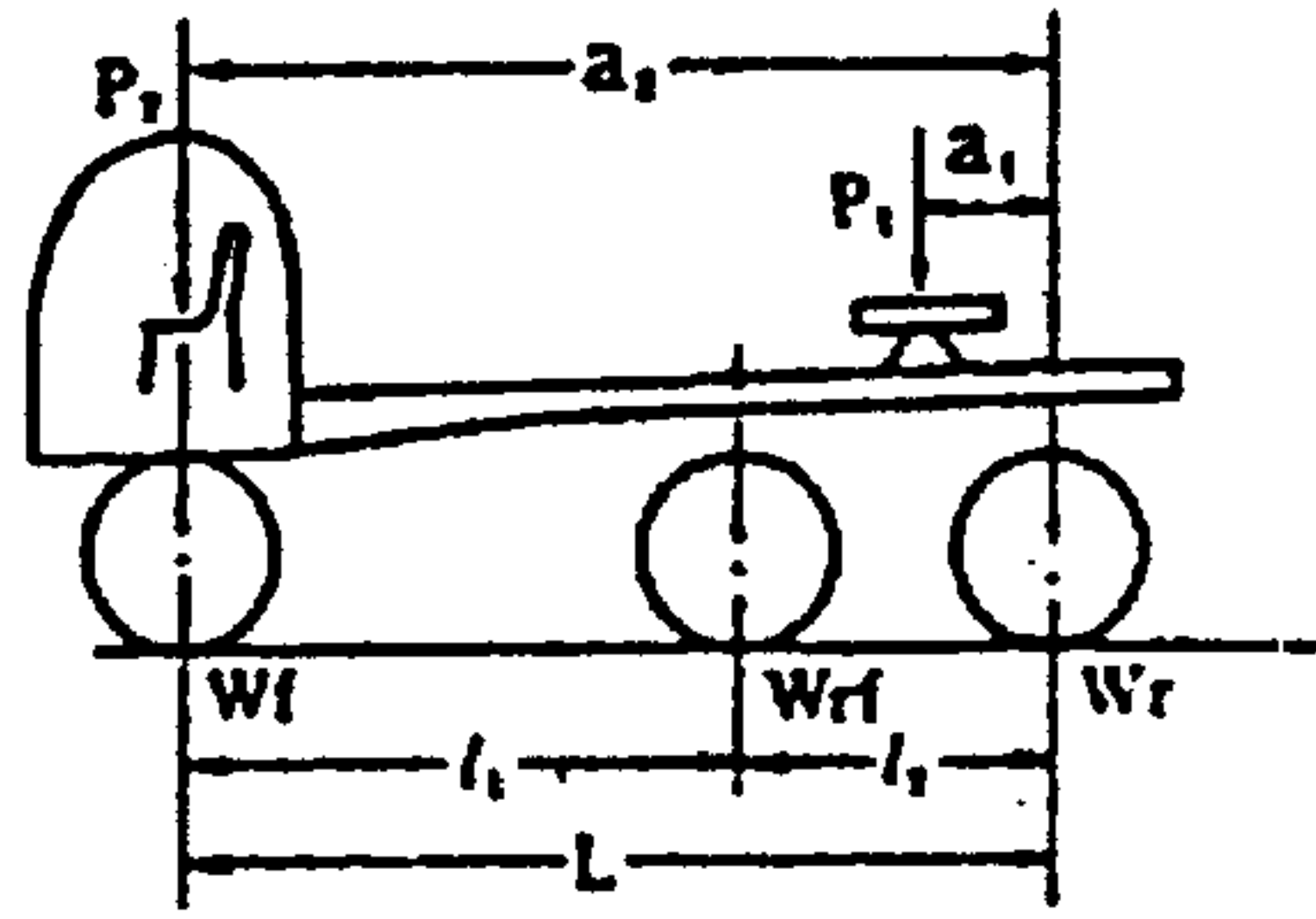


Fig 6. : Other three axles

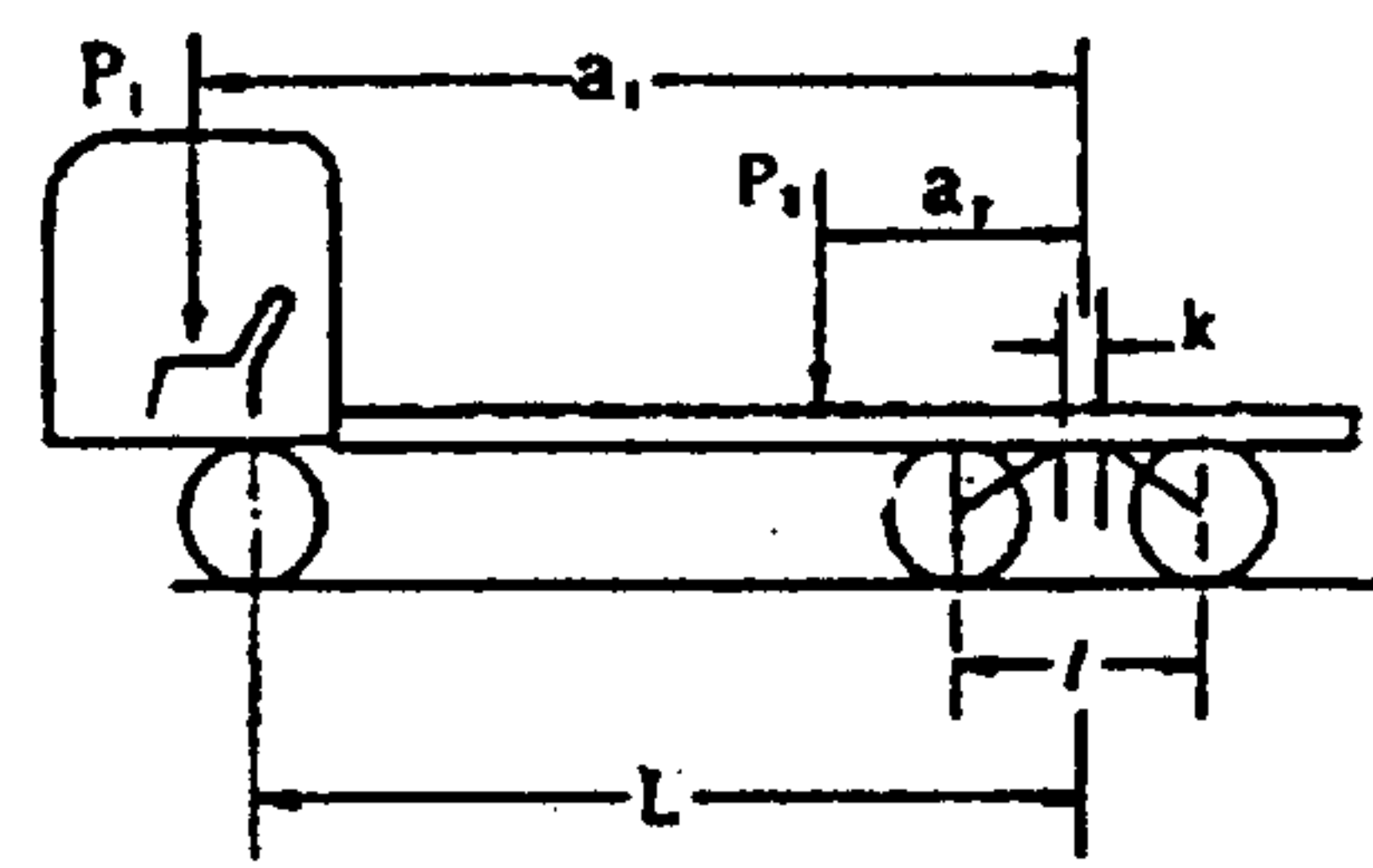


Fig 7. : Car with a trunnion shaft

(b) Axial independent two axles (Fig 2.)

$$W_f = \omega_f + \frac{\frac{\ell}{2} (W_{ff} - \omega_{fr})}{L} + P_f$$

$$W_r = W - W_f$$

$$P_f = \frac{a_1 P_1 + a_2 P_2 + \dots + a_n P_n}{L}$$

(c) Three axles except the clause (b) (Fig 6.)

$$W_f = W'_f + A_1 + \Delta W + B_1 \times \Delta M$$

$$W_m = W'_m + A_2 \times \Delta W + B_2 \times \Delta M$$

$$W_r = W - W_f - W_m$$

$$\text{But, } \Delta W = \omega - \omega'$$

$$\Delta M = (\omega_f - \omega'_f) \ell + (\omega_m - \omega'_m) \ell_2 + (a_1 - a'_1) P$$

A_1, B_1, A_2, B_2 : Integer as per the arrangement of a suspension and axle

(d) Three axles with a trunnion shaft

$$W_f = \omega_f + P_f$$

$$W_{r1} = W - (P - P_f) \frac{\frac{\ell}{2} + K}{\ell} \quad W_{r2} = W - (W_f + W_{r1})$$

$$P_f = \frac{(a_1 - K) P_1 + (a_2 - K) P_2 + \dots + (a_n - K) P_n}{L - K}$$

$$P = P_1 + P_2 + P_3 + \dots + P_n \quad \ell > 1 \text{ m}$$