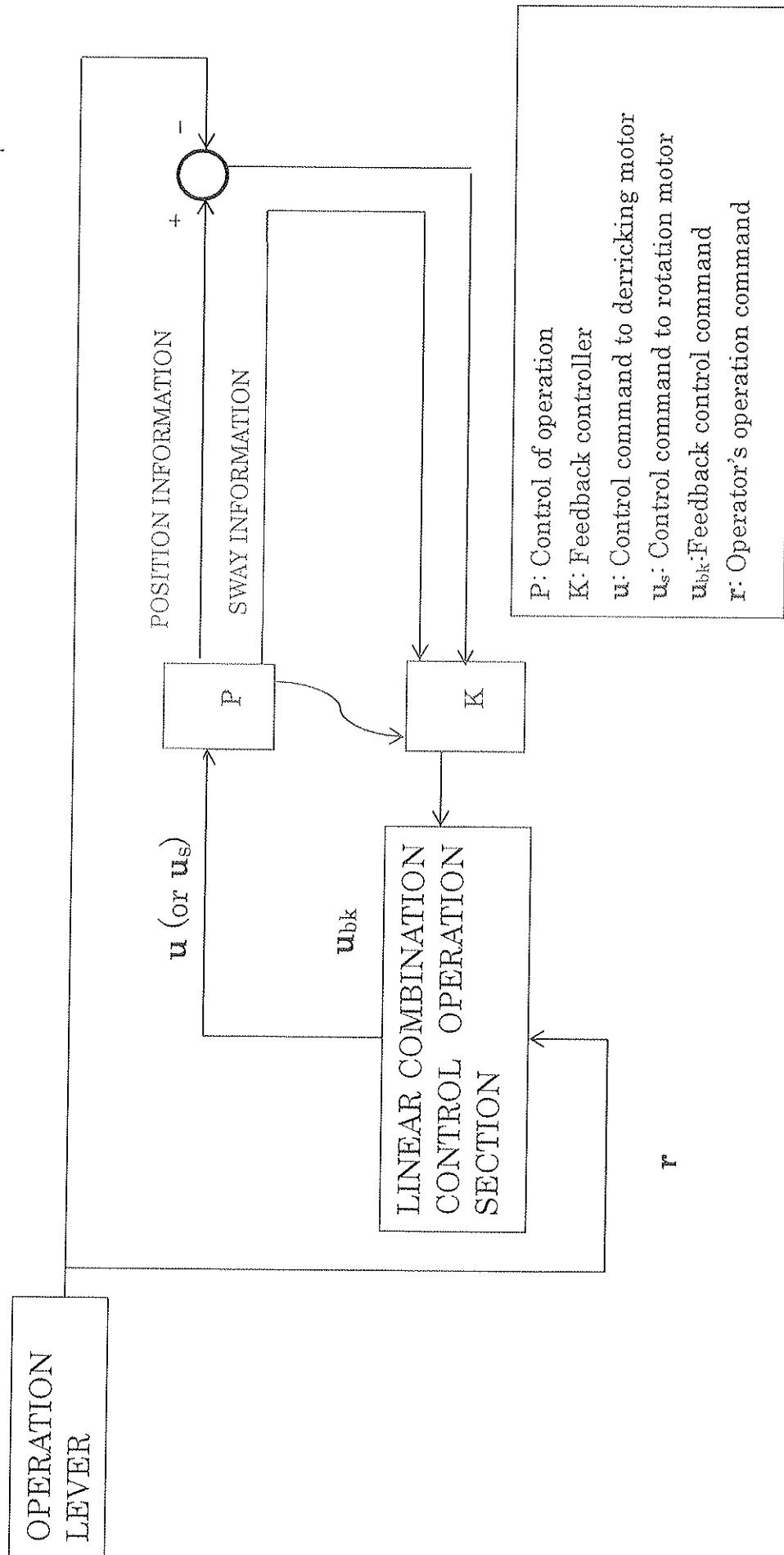
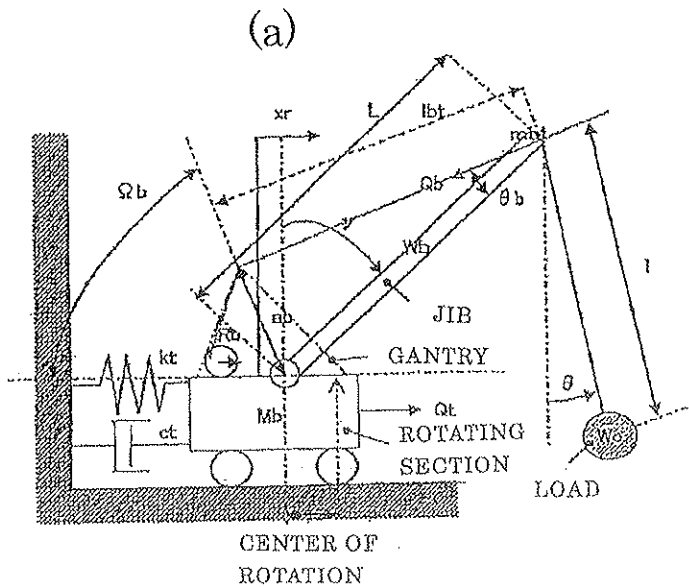


FIG.1

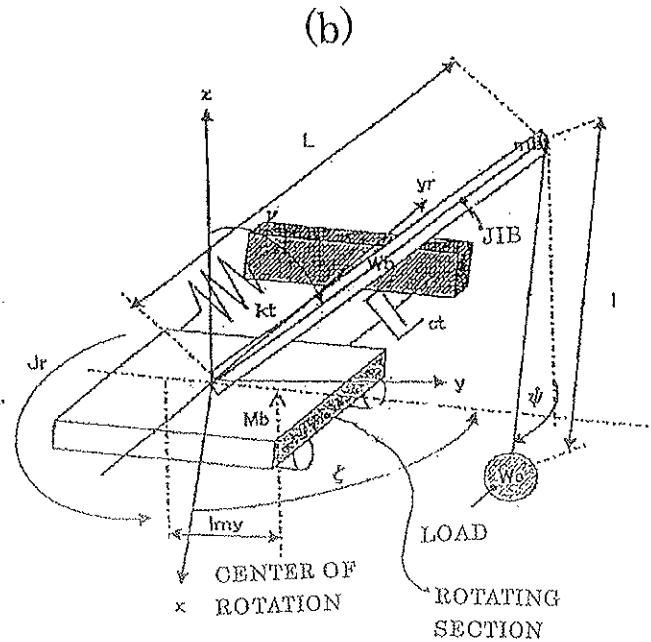


CONTROL SYSTEM BLOCK DIAGRAM

FIG. 2



LOWER DIMENSION MODEL
FOR DERRICKING CONTROL



LOWER DIMENSION MODEL
FOR ROTATION CONTROL

u : control input

x : absolute displacement of mast in x direction

x_r : absolute displacement of mast in x_r direction

y : absolute displacement of mast in y direction

y_r : absolute displacement of mast in y_r direction

v : derricking angle of jib

ζ : rotation angle of jib

θ : sway angle of load in derricking direction

ϕ : sway angle of load in rotational direction

Q_b : outside force applied to tip end of jib

Q_t : outside force applied to frame of rotation

J_r : moment of inertia about z -axis

l : load-rope length

L : length of jib

L_t : height of mast

R_b : radius of derricking drum

l_{bt} : distance from upper end of gantry to tip of jib

a : distance from center of rotation to lower end of jib

ab : distance from lower end of jib to upper end of gantry

l_{my} : distance from origin of highest portion of mast to center of gravitation of rotation frame

θ_b : angle of outside force Q_b to jib

Ω_b : angle of gantry to $x-y$ plane

W_b : weight of jib

m_{bt} : weight of tip portion of jib

W_o : weight of load

M_b : equivalent mass of lower dimension model

kt : equivalent spring constant of lower dimension model

ct : equivalent attenuation constant of lower dimension model

FIG. 3

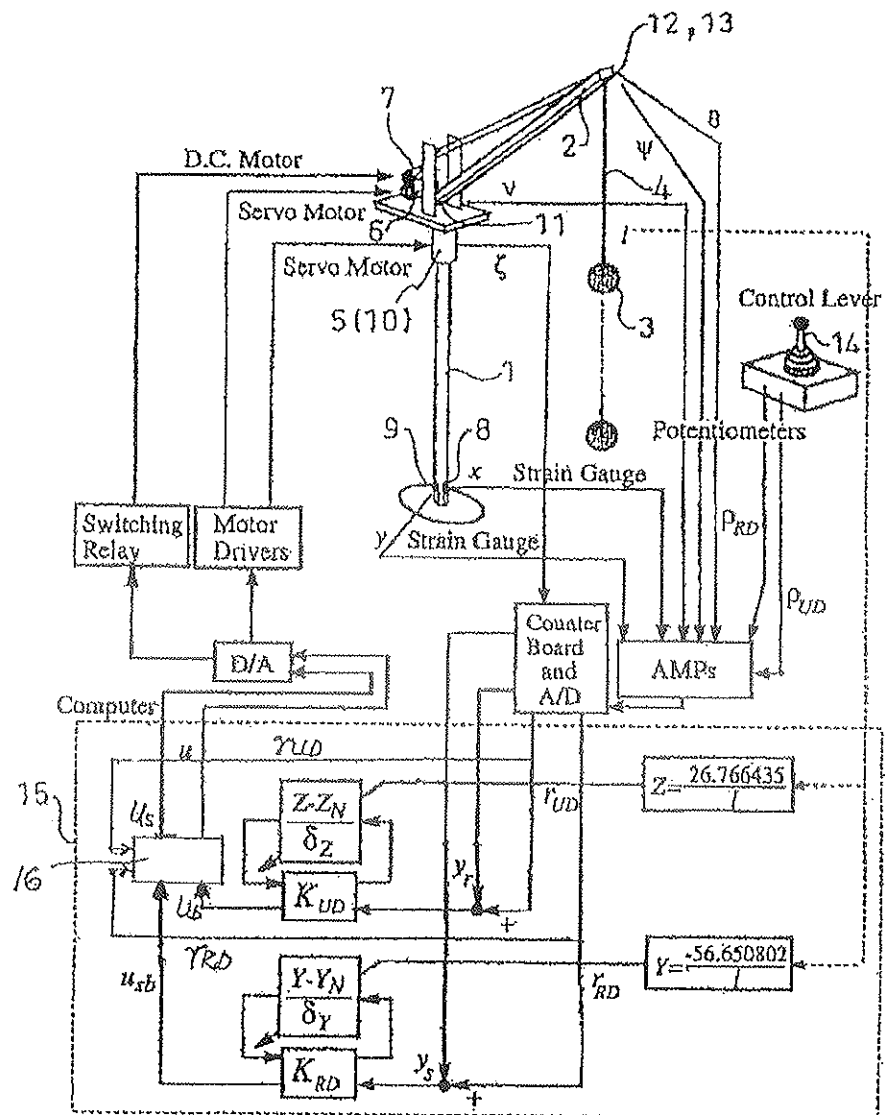


FIG. 4

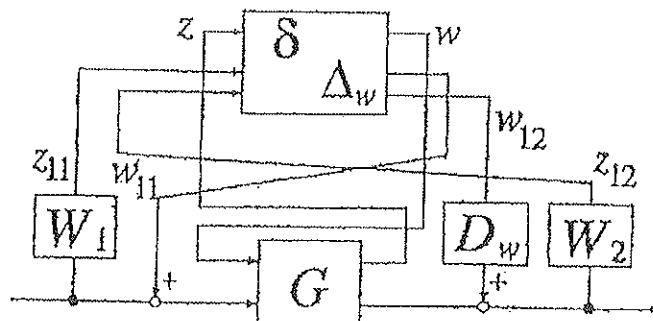
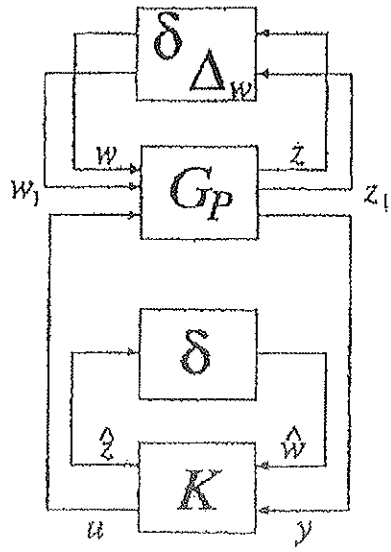


FIG. 5

(a)



(b)

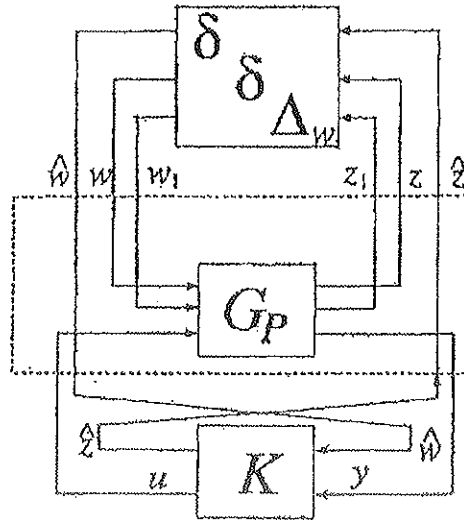
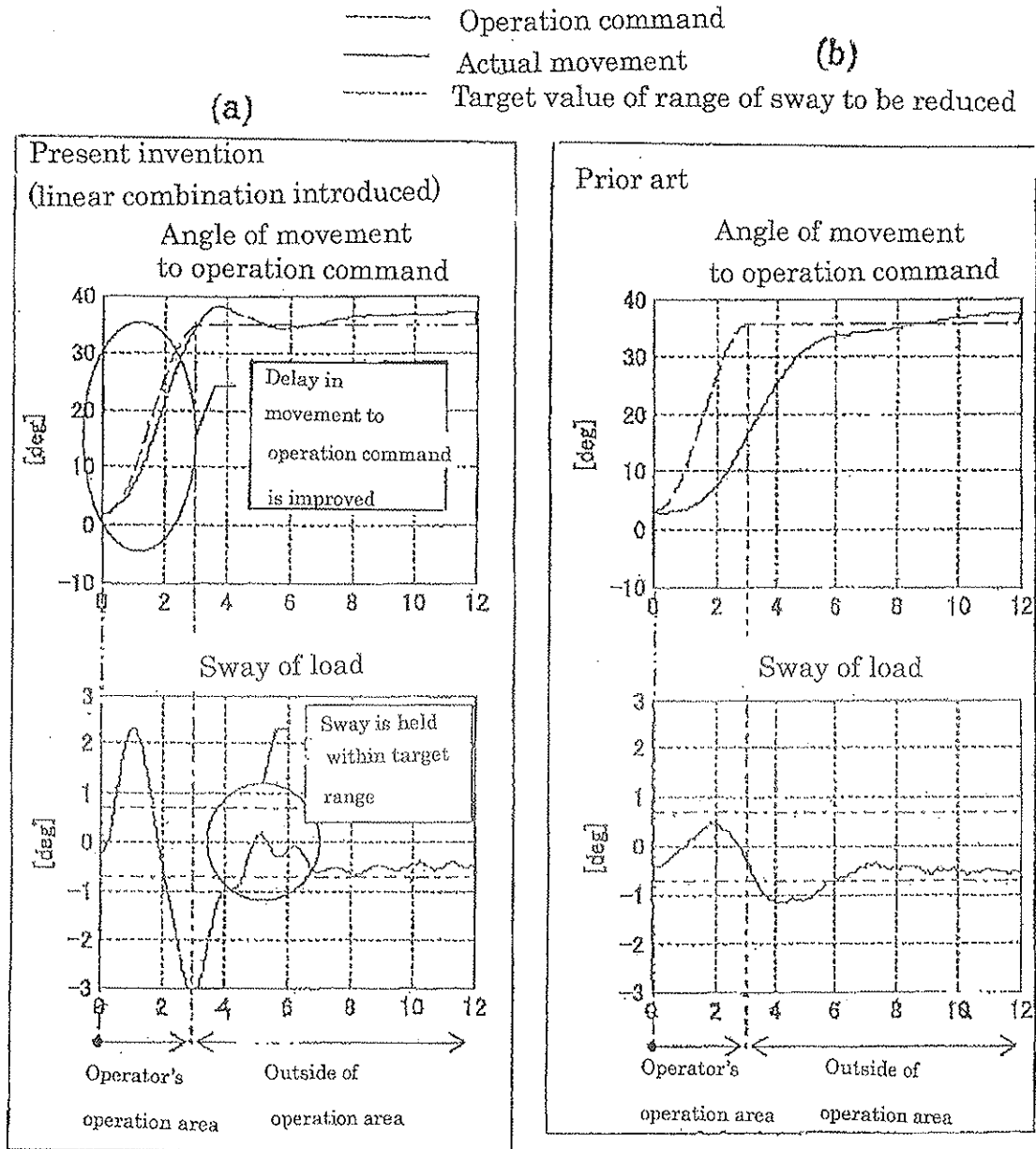
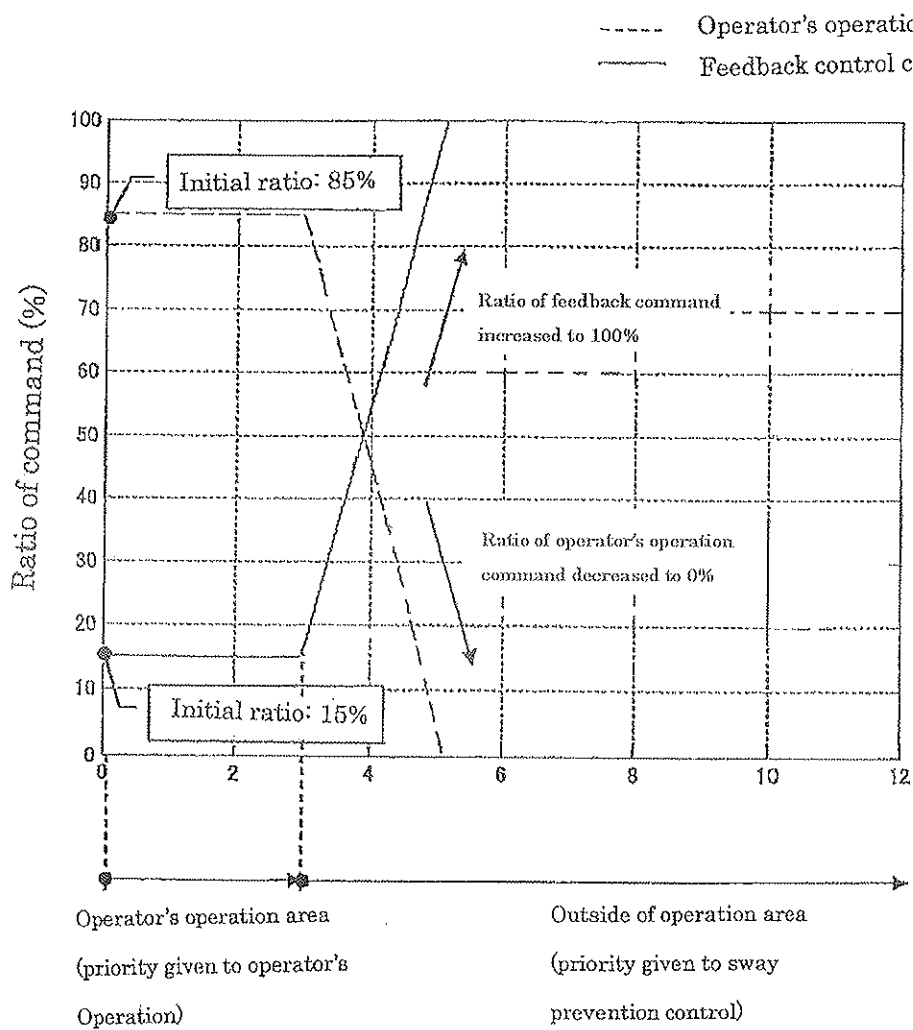


FIG. 6



Verification Test Data

FIG. 7



Timewise Variation in Ratio of Linear Combination
 (one example)