

1. What is the most probable cause of wide vertical gap between the handrail stand and the underside? Worn ____.
 - a) handrail
 - b) balustrade
 - c) handrail idler
 - d) handrail guide

2. During handrail inspection, you found out that the handrail is ahead of you in the direction of and travel before exiting. Is this normal?
 - a) Yes
 - b) No

3. What should be the normal setup of a Westinghouse upthrust safety device guide plates?
 - a) Free to move.
 - b) Maintenance free.
 - c) Tight and secured.
 - d) Has no operational bearing.

4. Montgomery KONE step upthrust safety switch should actuate when the hold down track is displaced by ____ inch or more?
 - a) 1/16
 - b) 3/16
 - c) 5/16
 - d) 9/16

5. If improper indexing of the step is noted at the LRS, all of the following are true, except?
 - a) Worn guide tracks.
 - b) Carriage bearings worn.
 - c) Uneven wear of the step chain.
 - d) LRS access cover plate out of alignment.

6. What is the typical gap maintained between the step and the skirt panel?
- a) 3/8 in.
 - b) 3/16 in.
 - c) 1/8 in.
 - d) 1/16 in.
7. What are the spring tensions set for the following escalators? All answers must be correct to earn a point.
- a) O & K _____
 - b) Montgomery _____
 - c) Westinghouse _____
 - d) Fujitec PS-ST 1200 _____
8. You should replace the coupling spider of Fujitec PS-ST 1200 when worn beyond its original thickness by _____?
- a) 25%
 - b) 50%
 - c) 1/3
 - d) 1/2
9. What is the maximum allowable clearance between the bottom front of the comb teeth and top of the step tread? No more than ____ inch?
- a) 3/32
 - b) 5/32
 - c) 1/16
 - d) 3/16
10. Westinghouse escalator step out-of-level switch will trip at ____ downward displacement?
- a) 1/16 in.
 - b) 3/16 in.
 - c) 1/8 in.
 - d) 3/8 in.

11. Which of the following would most likely actuate the step chain safety device?
- a) Step roller wear
 - b) Step chain wear.
 - c) Main drive chain wear.
 - d) Missing step chain roller.
12. To avoid excessive steps racking at the lower curve, what is the clearance of the step trailing wheel from the upthrust track with your weight on a step?
- a) 1/32 in.
 - b) 3/32 in.
 - c) 1/16 in.
 - d) 3/16 in.
13. What is the clearance between the pawl and the outer edge of the ratchet of the Westinghouse emergency brake?
- a) 1/8 in.
 - b) 3/8 in.
 - c) 5/8 in.
 - d) 7/8 in.
14. What other safety device of the O&K escalator is involved with the same switch as step sag monitor?
- a) Missing step
 - b) Upthrust safety
 - a) Step out-of-position
 - b) Upthrust safety out-of-opposition
15. Fujitec and Otis escalators LH & RH step axles must be lubricated semi-annually through the _____.
- a) washers
 - b) couplings
 - c) sleeve ports
 - d) roller bearings

16. What maintenance is required on Fujitec PS-ST 1200 NRO friction bearing?
- a) Clean and lubricate.
 - b) Clean and inspection only.
 - c) Clean and centering of bearing.
 - d) Inspection and spring adjustment.
17. How much oil should you fill in the gearbox?
- a) 1/3 of the worm gear
 - b) above the worm gear
 - c) 2/3 of the worm gear
 - d) below the worm gear
18. How often should you check the O&K Step Chain Wheel Upthrust clearance?
- a) Biweekly
 - b) Monthly
 - c) Quarterly
 - d) Semi-annually
19. How many minutes should you run the escalator after lubrication of step chains?
- a) 10
 - b) 15
 - c) 20
 - d) 25
20. What action should you take if you observed a Westinghouse escalator step chain rollers riding on top of the carriage sprockets after adjusting the spring tension?
- a) Replace the carriage.
 - b) Check for a broken chain.
 - c) Re-adjust the carriage spring tension.
 - d) Make a report to your Foreworker for a step chain job.

21. What is the status of the Westinghouse directional switch with the unit stop?
- a) Both sets of contacts are closed.
 - b) Both sets of contacts are opened.
 - c) Hard to determine since the unit is not running.
 - d) One set is closed and the opposite set is opened.
22. Fujitec PS-S 1200 emergency brake shoe is located at the ____?
- a) Inside the top pit.
 - b) Upper transition inside the stepband.
 - c) Below the upper transition inside the stepband.
 - d) Not required since Fujitec PS-S 1200 is gear driven.
23. The arrows in figure 8-9 below are pointing directly at what areas for lubrication? Between the _____, and between the _____.
- a) chain links and pins, chain rollers and chain pins.
 - b) outside and the inside chain links, inside chain links and rollers.
 - c) chain barrels and outside chain links, chain roller pins and wheels.
 - d) outside and inside chain couplings, inside chain roller and chain links.

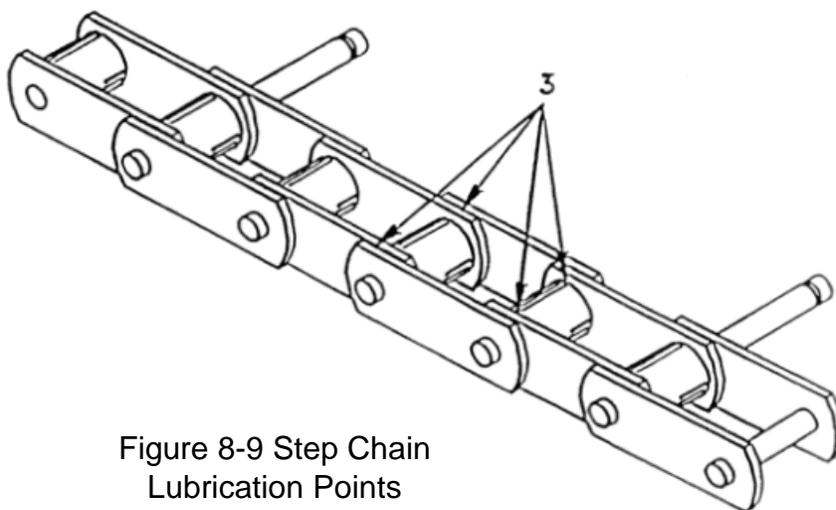


Figure 8-9 Step Chain
Lubrication Points

24. What should be the gap between the switch roller and inside of the cam in figure 8-9a arrow #1?

- a) 1/16 in.
- b) 1/8 in.
- c) 1/4 in.
- d) 1/2 in.

25. What should be the gap between the cam and the switch roller on the uphill in figure 8-9a arrow #2?

- a) 1/4 in. to 1/2 in.
- b) 1/16 in. to 1/8 in.
- c) 1/8 in. to 1/4 in.
- d) 1/8 in. to 1/3 in.

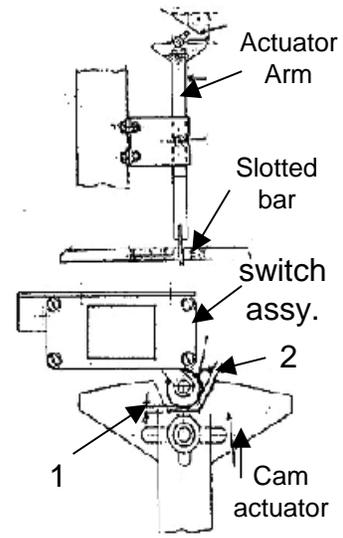


Figure 8-9a Westinghouse Escalator Broken Step Chain Safety

26. How would you adjust the actuator arm in figure 8 - 9a if the cam actuator reaches maximum adjustment?

- a) Make new holes in the slotted bar.
- b) Slide and reposition the slotted bar.
- c) Remove the actuator arm from its bracket and replace.
- d) Left up the actuator arm from the slotted bar and reposition.

27. How would you know that an O&K step chains are worn out and elongated?

- a) The spring lock nut is against the kicker lock nut.
- b) The carriage shaft is against the inner circle track.
- c) The carriage sliding bars are against the adjustment holder.
- d) There is a maximum down travel of the guide wheels in the sway bar.

28. Where can you detect Montgomery escalator step chain elongation?

- a) Wide gaps at the top landing make-up tracks.
- b) Wide gaps at the bottom landing make-up tracks.
- c) Step chains riding on top of carriage gear sprockets.
- d) Wide gap between two consecutive steps at the incline.

29. What action should you take if part #6 is against part #7 in figure 8-9c below?
- Reposition part #2.
 - Adjust part #5 to compensate.
 - Adjust part #7 closer to part #3.
 - Report to your Foreworker that the step chains are worn.

30. Match the part named below with the numbers in figure 8-9c. All must be correct to get one point.

- | | |
|----------------------|-------|
| a) Spring | _____ |
| b) Jam nut | _____ |
| c) Sliding block | _____ |
| d) Adjustment holder | _____ |

31. What is the clearance between the plunger of part #3 against the hub of part #4?

- 1/16 in.
- 1/8 in.
- 3/8 in.
- 1/4 in.

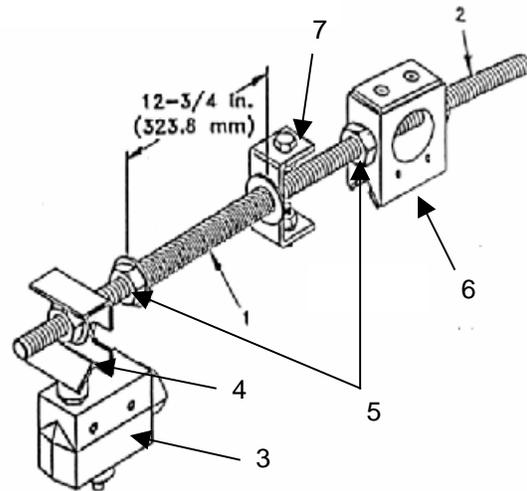


Figure 8-9c Montgomery and Montgomery KONE Carriage Spring

32. What is the status of part #6 in figure 8-9c when the carriage oscillates due to load change in the stepband?
- It does not move.
 - Moves with the carriage.
 - It is not attached to the carriage.
 - Has no bearing with the oscillation of carriage.

33. What is the clearance between the step trail wheel lug and the upthrust track bar in figure 8-10j?

- a) 1/32 in.
- b) 1/16 in.
- c) 3/16 in.
- d) 1/8 in.

34. What is the clearance between the inlet guideway track and the step trail wheel in figure 8-10j?

- a) 1/32 in.
- b) 1/16 in.
- c) 3/16 in.
- d) 1/8 in.

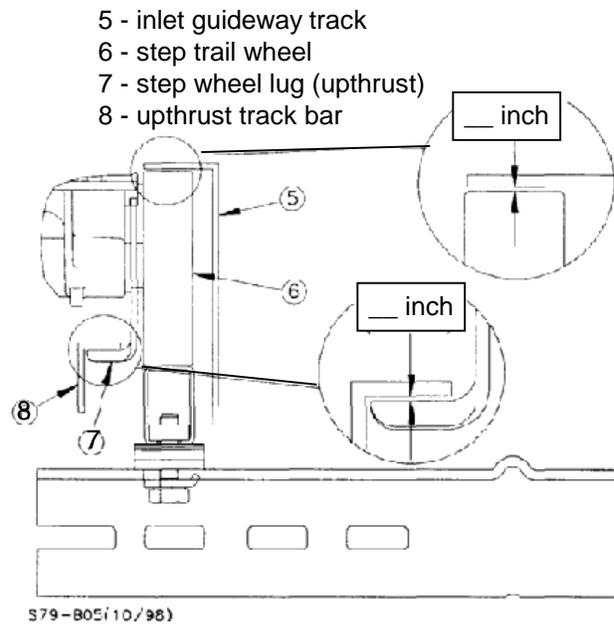


Figure 8-10j O&K Step Chain Wheel Upthrust Clearance

35. What part in figure 8-10i will pull the guideway back in place when lifted?

- a) Adjusting nut.
- b) Spacer block.
- c) Trail wheel track.
- d) Stationary actuator.

36. Where would you find LH & RH Step Lift Monitor of O&K escalator?

- a) Upper curve.
- b) Lower curve.
- c) Both at the upper and lower curves.
- d) At the incline just above lower curve.

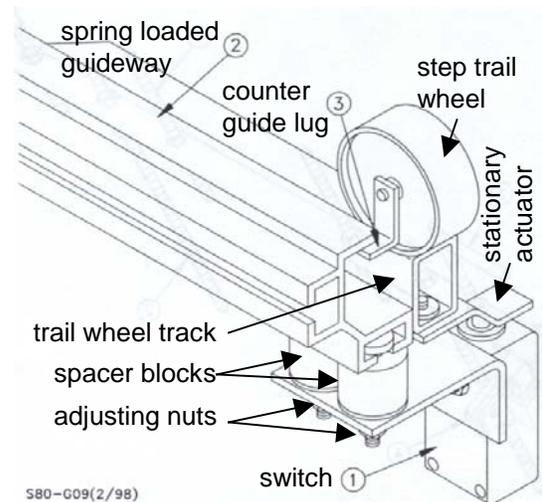


Figure 8-10i O&K Step Lift Monitor

37. Should you replace a comb section even it has only one missing tooth?

- a) True
- b) False

38. To get one point, match all the parts below with the numbers in figure 8-10e.

- a) Upthrust safety guard bar ____
- b) Lever adjusting screws ____
- c) Switch assembly ____
- d) Lever/actuator ____

39. What is the clearance between part #3 and the plunger of part #4 in figure 8-10e?

- a) 1/32 in.
- b) 1/16 in.
- c) 3/16 in.
- d) 1/8 in.

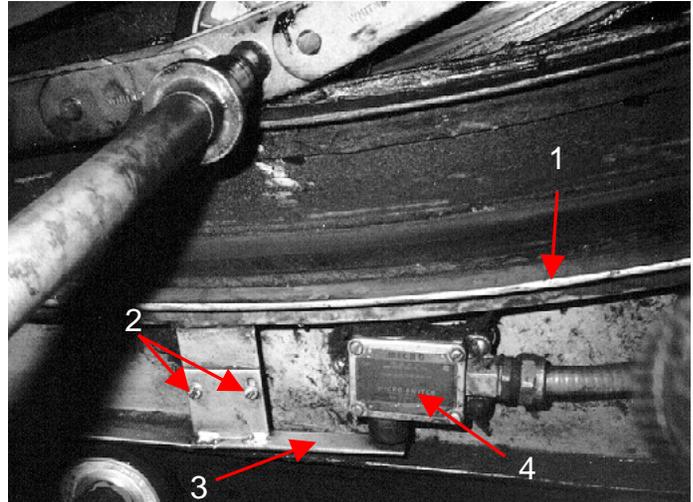


Figure 8-10e Westinghouse Escalator
LH Upthrust Safety Device

40. How would you set the clearance between part #3 and part #4 in figure 8-10e?

- a) Adjust the plunger of part #4.
- b) Loosen the mounting screws of part #4.
- c) Loosen part #2 to adjust part #3 against plunger of part #4
- d) Adjust part #1 to move part #3 against the plunger of part #4.

41. What will happen in figure 8-10e if the steps at the lower curve were jammed? The step ____.

- a) T-bar will lift part #1 to lift part #4 to actuate.
- b) trailing wheels will lift part #1 to actuate part #4.
- c) trailing wheels will press part #4 against part #3.
- d) T-bar will lift part #1 to lift part #3 against the actuator of part #4.

42. How many step upthrust safety device switch(es) are/is installed in Montgomery KONE escalator?

- a) 1
- b) 2
- c) 3

d) 4

43. What is the gap between the step T-bar and the guide in figure 8-10k?

- a) 0.12 in.
- b) 0.16 in.
- c) 0.18 in.
- d) 0.20 in.

44. What maintenance is required for the sliding part of figure 8-10k?

- a) Adjust to hold firmly.
- b) Clean and lubricate.
- c) Adjust with the bracket.
- d) No required maintenance.

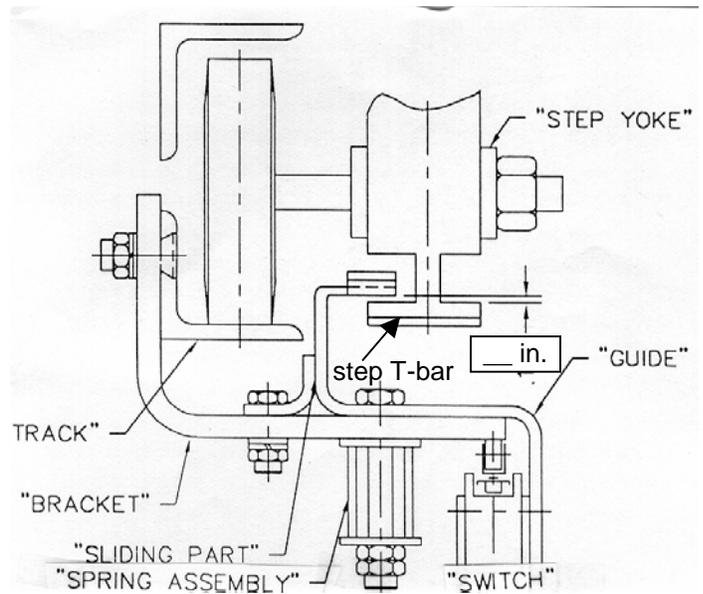


Figure 8-10k Fujitec LH Upthrust Safety Device

45. When two consecutive steps are jammed at the lower curve, the step T-bar _.

- a) tilts the guide against the bracket for the switch to open.
- b) pushes the track down against the guide to open the switch.
- c) pulls the guide against the spring and bracket for the switch to open.
- d) pushes the guide against the spring and bracket for the switch to open.

46. What is the maximum stopping distance of unloaded escalator from the location of the switch to the combplate? Should not exceed ____.

- a) one foot from the skirt switch to the combplate.
- b) seven inches from the skirt switch to the combplate.
- c) the distance from the location of the switch to the combplate.
- d) the distance from the location of the skirt brushes to the combplate.

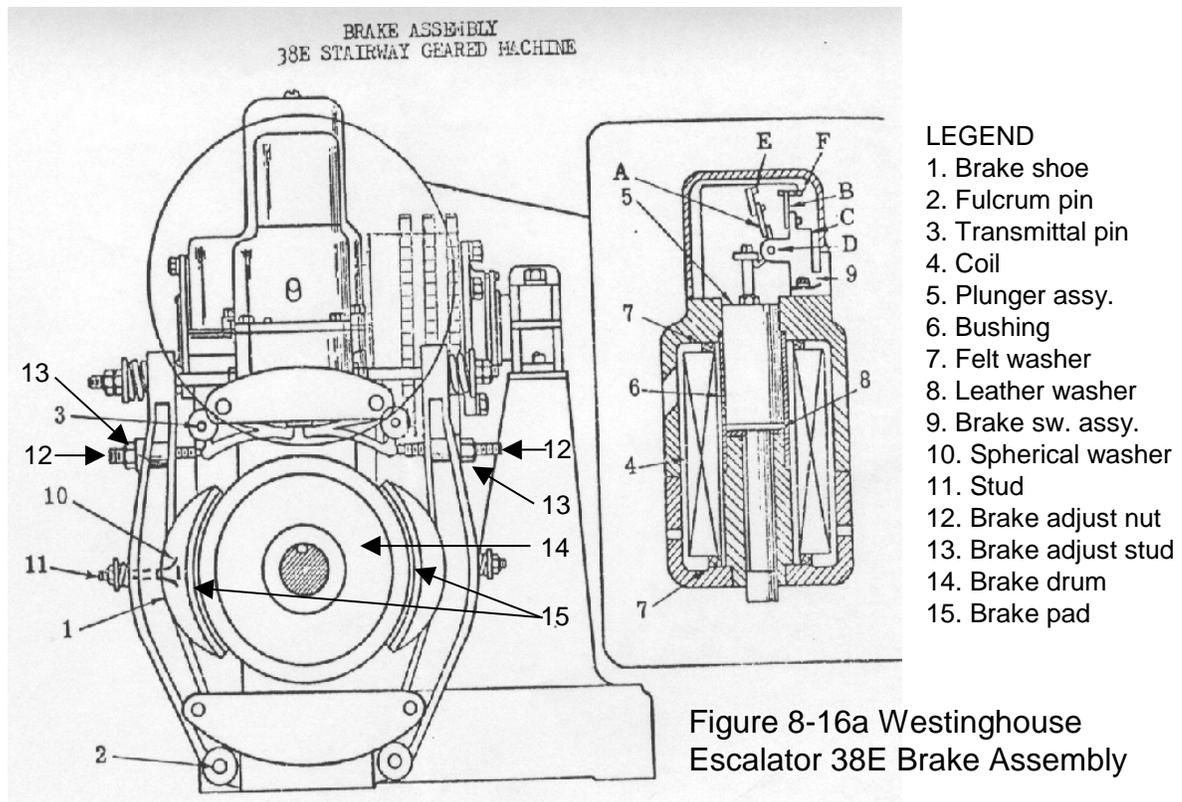
47. What action should you do if you found a Westinghouse escalator stopping distance in the down travel to be more than 8 in. at 120 fpm?

- a) Adjust the brake plunger to 3/16 in.

- b) Adjust the brake spring tension to 1 ½ in.
- c) Make a report to your Foreworker for brake pad replacement.
- d) Inspect the main drive chain for slack to be no more than ½ in. from taut.

48. What part numbers in figure 8-16a requires lubrication.

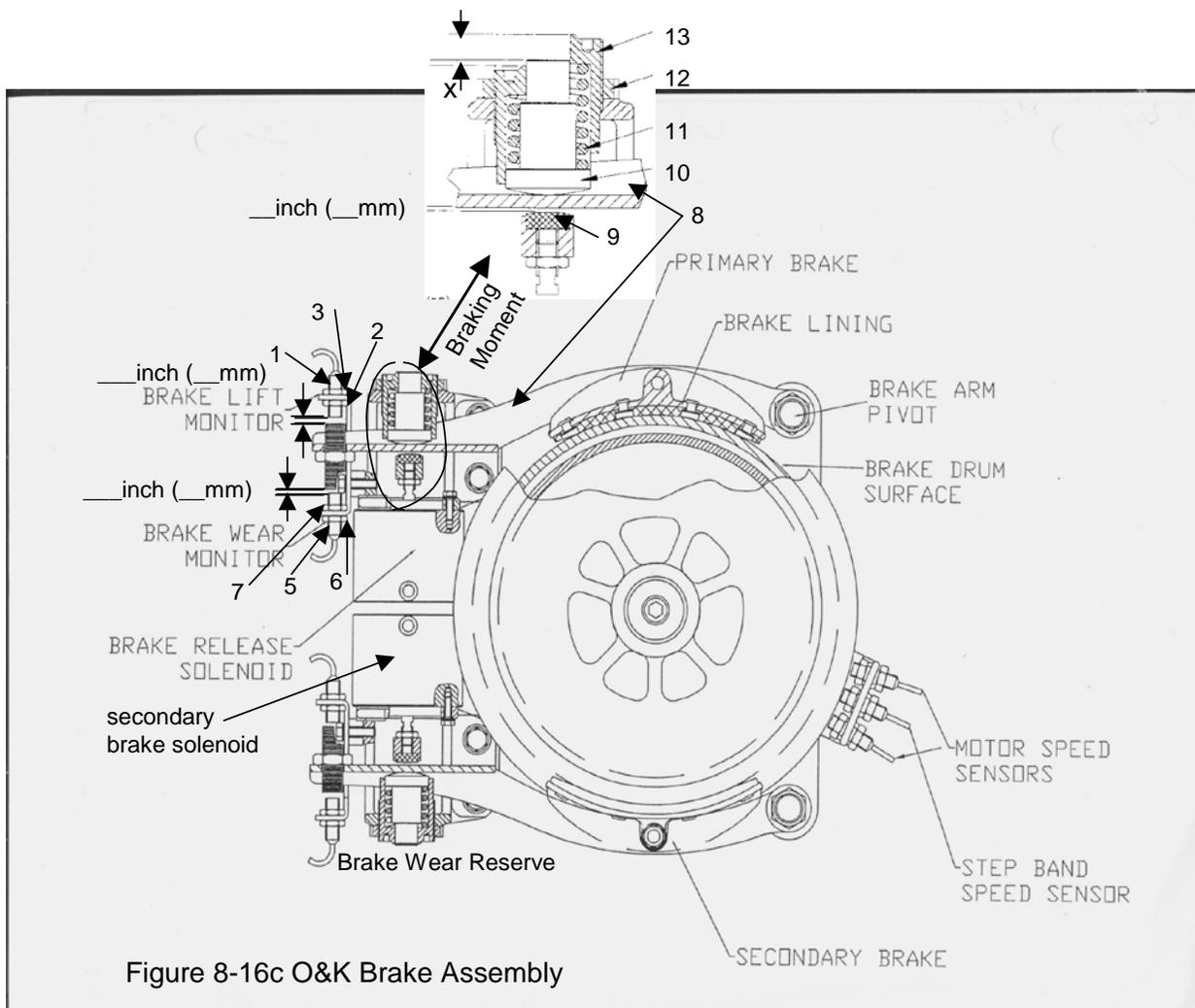
- a) 1 & 2
- b) 2 & 3
- c) 2 & 13
- d) 3 & 13



49. You should replace the brake pads in figure 8-16a above when the lining is ___ or less than the original thickness.

- a) 1/3
- b) ¼
- c) ½
- d) 2/3

50. Which brake engages first in figure 8-16c in page 13?
- Primary brake
 - Secondary brake
51. What is the brake wear monitor gap setting in figure 8-16c?
- 5/64 in. (2mm)
 - 1/16 in. (1.6mm)
 - 3/32 in. (2.3mm)
 - 9/64 in. (3.4mm)



52. What is the brake lift monitor gap setting in figure 8-16c above?
- 5/64 in. (2mm)

- b) 1/16 in. (1.6mm)
- c) 3/32 in. (2.3mm)
- d) 9/64 in. (3.4mm)

53. What is the minimum brake lining thickness of an O&K escalator?

- a) 5/64 in. (2mm)
- b) 3/32 in. (2.3mm)
- c) 1/8 in. (3mm).
- d) 9/64 in. (3.4mm)

54. How many brakes are there in an O&K escalator with dual machine?

- a) 1
- b) 2
- c) 3
- d) 4

Module 8 Final Exam
Escalator Preventive Maintenance

NAME (Print) _____

First

Middle Initial

Last

Employee Number _____

Date _____

INSTRUCTIONS: Before starting, fill in your name, employee number and the date.

When answering, read each question carefully. Read ALL answers before selecting the answer that is **most correct**. Using ink or ball point-pen, circle the answer that indicates your choice. **Select only ONE answer.**

When changing a previously selected answer, circle the answer you WANT and cross out your previous selection then initial it. **MAKE CORRECTIONS OBVIOUS.**

EXAMPLE:

The third rail is electrified with?

- e) 500 volts DC
- f) 1000 volts DC
- g) 500 volts AC
- h) 1000 volts AC

55. What is the most probable cause of wide vertical gap between the handrail stand and the underside? Worn _____.

- a) handrail
- b) balustrade
- c) handrail idler
- d) handrail guide

56. During handrail inspection, you found out that the handrail is ahead of you in the direction of and travel before exiting. Is this normal?

- c) Yes
- d) No

57. What should be the normal setup of a Westinghouse upthrust safety device guide plates?

- a) Free to move.
- b) Maintenance free.
- c) Tight and secured.
- d) Has no operational bearing.

58. Montgomery KONE step upthrust safety switch should actuate when the hold down track is displaced by ____ inch or more?

- a) 1/16
- b) 3/16
- c) 5/16
- d) 9/16

59. If improper indexing of the step is noted at the LRS, all of the following are true, except?

- a) Worn guide tracks.
 - b) Carriage bearings worn.
 - c) Uneven wear of the step chain.
 - d) LRS access cover plate out of alignment.
60. What is the typical gap maintained between the step and the skirt panel?
- a) 3/8 in.
 - b) 3/16 in.
 - c) 1/8 in.
 - d) 1/16 in.
61. What are the spring tensions set for the following escalators? All answers must be correct to earn a point.
- a) O & K _____
 - b) Montgomery _____
 - c) Westinghouse _____
 - d) Fujitec PS-ST 1200 _____
62. You should replace the coupling spider of Fujitec PS-ST 1200 when worn beyond its original thickness by _____?
- a) 25%
 - b) 50%
 - c) 1/3
 - d) 1/2
63. What is the maximum allowable clearance between the bottom front of the comb teeth and top of the step tread? No more than ____ inch?
- a) 3/32
 - b) 5/32
 - c) 1/16
 - d) 3/16
64. Westinghouse escalator step out-of-level switch will trip at ____ downward displacement?

- a) 1/16 in.
 - b) 3/16 in.
 - c) 1/8 in.
 - d) 3/8 in.
65. Which of the following would most likely actuate the step chain safety device?
- a) Step roller wear
 - b) Step chain wear.
 - c) Main drive chain wear.
 - d) Missing step chain roller.
66. To avoid excessive steps racking at the lower curve, what is the clearance of the step trailing wheel from the upthrust track with your weight on a step?
- a) 1/32 in.
 - b) 3/32 in.
 - c) 1/16 in.
 - d) 3/16 in.
67. What is the clearance between the pawl and the outer edge of the ratchet of the Westinghouse emergency brake?
- a) 1/8 in.
 - b) 3/8 in.
 - c) 5/8 in.
 - d) 7/8 in.
68. What other safety device of the O&K escalator is involved with the same switch as step sag monitor?
- a) Missing step
 - b) Upthrust safety
 - a) Step out-of-position
 - b) Upthrust safety out-of-opposition

69. Fujitec and Otis escalators LH & RH step axles must be lubricated semi-annually through the _____.
- a) washers
 - b) couplings
 - c) sleeve ports
 - d) roller bearings
70. What maintenance is required on Fujitec PS-ST 1200 NRO friction bearing?
- a) Clean and lubricate.
 - b) Clean and inspection only.
 - c) Clean and centering of bearing.
 - d) Inspection and spring adjustment.
71. How much oil should you fill in the gearbox?
- a) 1/3 of the worm gear
 - b) above the worm gear
 - c) 2/3 of the worm gear
 - d) below the worm gear
72. How often should you check the O&K Step Chain Wheel Upthrust clearance?
- a) Biweekly
 - b) Monthly
 - c) Quarterly
 - d) Semi-annually
73. How many minutes should you run the escalator after lubrication of step chains?
- a) 10
 - b) 15
 - c) 20
 - d) 25

74. What action should you take if you observed a Westinghouse escalator step chain rollers riding on top of the carriage sprockets after adjusting the spring tension?
- a) Replace the carriage.
 - b) Check for a broken chain.
 - c) Re-adjust the carriage spring tension.
 - d) Make a report to your Foreworker for a step chain job.
75. What is the status of the Westinghouse directional switch with the unit stop?
- a) Both sets of contacts are closed.
 - b) Both sets of contacts are opened.
 - c) Hard to determine since the unit is not running.
 - d) One set is closed and the opposite set is opened.
76. Fujitec PS-S 1200 emergency brake shoe is located at the ____?
- a) Inside the top pit.
 - b) Upper transition inside the stepband.
 - c) Below the upper transition inside the stepband.
 - d) Not required since Fujitec PS-S 1200 is gear driven.
77. The arrows in figure 8-9 below are pointing directly at what areas for lubrication? Between the _____, and between the _____.
- a) chain links and pins, chain rollers and chain pins.
 - b) outside and the inside chain links, inside chain links and rollers.
 - c) chain barrels and outside chain links, chain roller pins and wheels.
 - d) outside and inside chain couplings, inside chain roller and chain links.

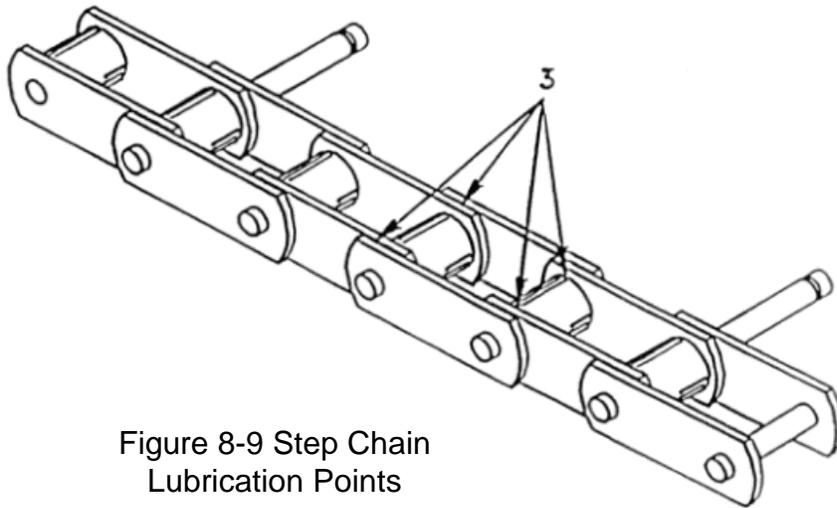


Figure 8-9 Step Chain Lubrication Points

78. What should be the gap between the switch roller and inside of the cam in figure 8-9a arrow #1?

- a) 1/16 in.
- b) 1/8 in.
- c) 1/4 in.
- d) 1/2 in.

79. What should be the gap between the cam and the switch roller on the uphill in figure 8-9a arrow #2?

- a) 1/4 in. to 1/2 in.
- b) 1/16 in. to 1/8 in.
- c) 1/8 in. to 1/4 in.
- d) 1/8 in. to 1/3 in.

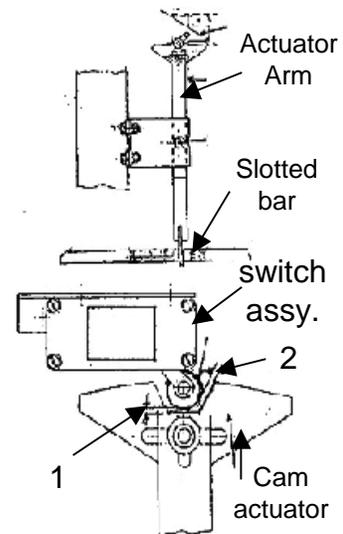


Figure 8-9a Westinghouse Escalator Broken Step Chain Safety

80. How would you adjust the actuator arm in figure 8 - 9a if the cam actuator reaches maximum adjustment?

- a) Make new holes in the slotted bar.
- b) Slide and reposition the slotted bar.
- c) Remove the actuator arm from its bracket and replace.
- d) Left up the actuator arm from the slotted bar and reposition.

81. How would you know that an O&K step chains are worn out and elongated?
- a) The spring lock nut is against the kicker lock nut.
 - b) The carriage shaft is against the inner circle track.
 - c) The carriage sliding bars are against the adjustment holder.
 - d) There is a maximum down travel of the guide wheels in the sway bar.

82. Where can you detect Montgomery escalator step chain elongation?
- a) Wide gaps at the top landing make-up tracks.
 - b) Wide gaps at the bottom landing make-up tracks.
 - c) Step chains riding on top of carriage gear sprockets.
 - d) Wide gap between two consecutive steps at the incline.

83. What action should you take if part #6 is against part #7 in figure 8-9c below?
- a) Reposition part #2.
 - b) Adjust part #5 to compensate.
 - c) Adjust part #7 closer to part #3.
 - d) Report to your Foreworker that the step chains are worn.

84. Match the part named below with the numbers in figure 8-9c. All must be correct to get one point.

- a) Spring _____
- b) Jam nut _____
- c) Sliding block _____
- d) Adjustment holder _____

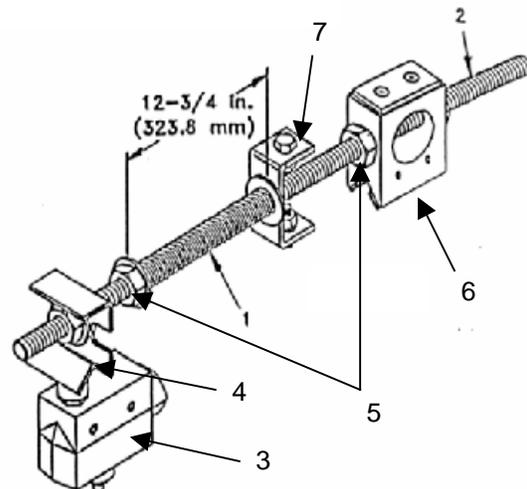


Figure 8-9c Montgomery and Montgomery KONE Carriage Spring

85. What is the clearance between the plunger of part #3 against the hub of part #4?
- a) 1/16 in.
 - b) 1/8 in.
 - c) 3/8 in.
 - d) 1/4 in.

86. What is the status of part #6 in figure 8-9c when the carriage oscillates due to load change in the stepband?
- It does not move.
 - Moves with the carriage.
 - It is not attached to the carriage.
 - Has no bearing with the oscillation of carriage.

87. What is the clearance between the step trail wheel lug and the upthrust track bar in figure 8-10j?

- 1/32 in.
- 1/16 in.
- 3/16 in.
- 1/8 in.

88. What is the clearance between the inlet guideway track and the step trail wheel in figure 8-10j?

- 1/32 in.
- 1/16 in.
- 3/16 in.
- 1/8 in.

89. What part in figure 8-10i will pull the guideway back in place when lifted?

- Adjusting nut.
- Spacer block.
- Trail wheel track.
- Stationary actuator.

90. Where would you find LH & RH Step Lift Monitor of O&K escalator?

- Upper curve.

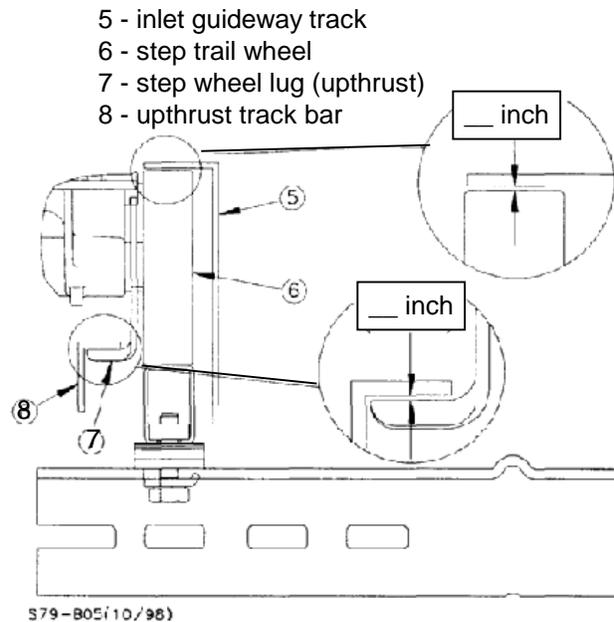


Figure 8-10j O&K Step Chain Wheel Upthrust Clearance

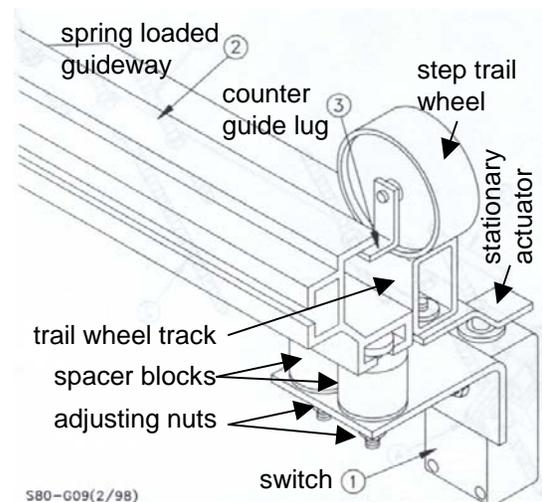


Figure 8-10i O&K Step Lift Monitor

- b) Lower curve.
- c) Both at the upper and lower curves.
- d) At the incline just above lower curve.

91. Should you replace a comb section even it has only one missing tooth?

- a) True
- b) False

92. To get one point, match all the parts below with the numbers in figure 8-10e.

- a) Upthrust safety guard bar ____
- b) Lever adjusting screws ____
- c) Switch assembly ____
- d) Lever/actuator ____

93. What is the clearance between part #3 and the plunger of part #4 in figure 8-10e?

- a) 1/32 in.
- b) 1/16 in.
- c) 3/16 in.
- d) 1/8 in.

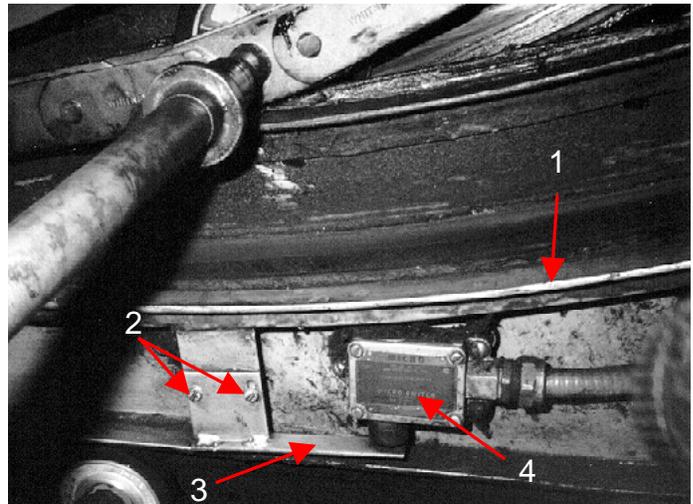


Figure 8-10e Westinghouse Escalator
LH Upthrust Safety Device

94. How would you set the clearance between part #3 and part #4 in figure 8-10e?

- a) Adjust the plunger of part #4.
- b) Loosen the mounting screws of part #4.
- c) Loosen part #2 to adjust part #3 against plunger of part #4
- d) Adjust part #1 to move part #3 against the plunger of part #4.

95. What will happen in figure 8-10e if the steps at the lower curve were jammed? The step ____.

- a) T-bar will lift part #1 to lift part #4 to actuate.
- b) trailing wheels will lift part #1 to actuate part #4.

- c) trailing wheels will press part #4 against part #3.
- d) T-bar will lift part #1 to lift part #3 against the actuator of part #4.

96. How many step upthrust safety device switch(es) are/is installed in Montgomery KONE escalator?

- a) 1
- b) 2
- c) 3
- d) 4

97. What is the gap between the step T-bar and the guide in figure 8-10k?

- a) 0.12 in.
- b) 0.16 in.
- c) 0.18 in.
- d) 0.20 in.

98. What maintenance is required for the sliding part of figure 8-10k?

- a) Adjust to hold firmly.
- b) Clean and lubricate.
- c) Adjust with the bracket.
- d) No required maintenance.

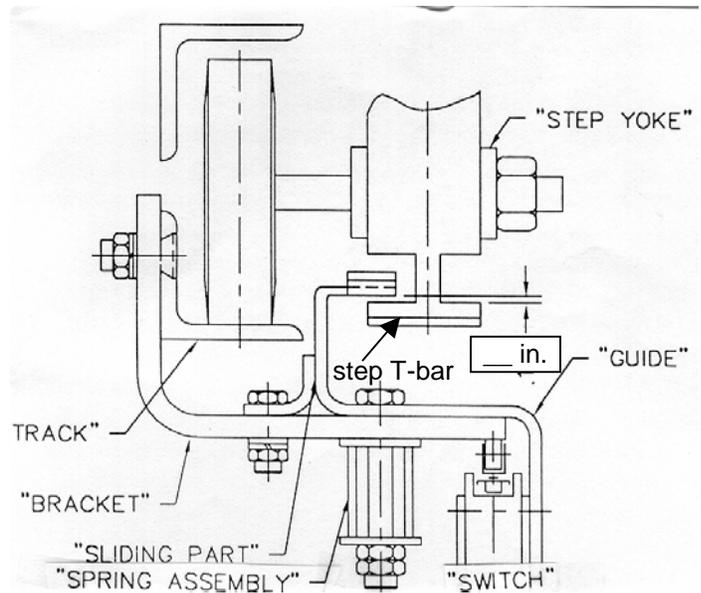


Figure 8-10k Fujitec LH Upthrust Safety Device

99. When two consecutive steps are jammed at the lower curve, the step T-bar _.

- a) tilts the guide against the bracket for the switch to open.
- b) pushes the track down against the guide to open the switch.
- c) pulls the guide against the spring and bracket for the switch to open.
- d) pushes the guide against the spring and bracket for the switch to open.

100. What is the maximum stopping distance of unloaded escalator from the location of the switch to the combplate? Should not exceed ____.

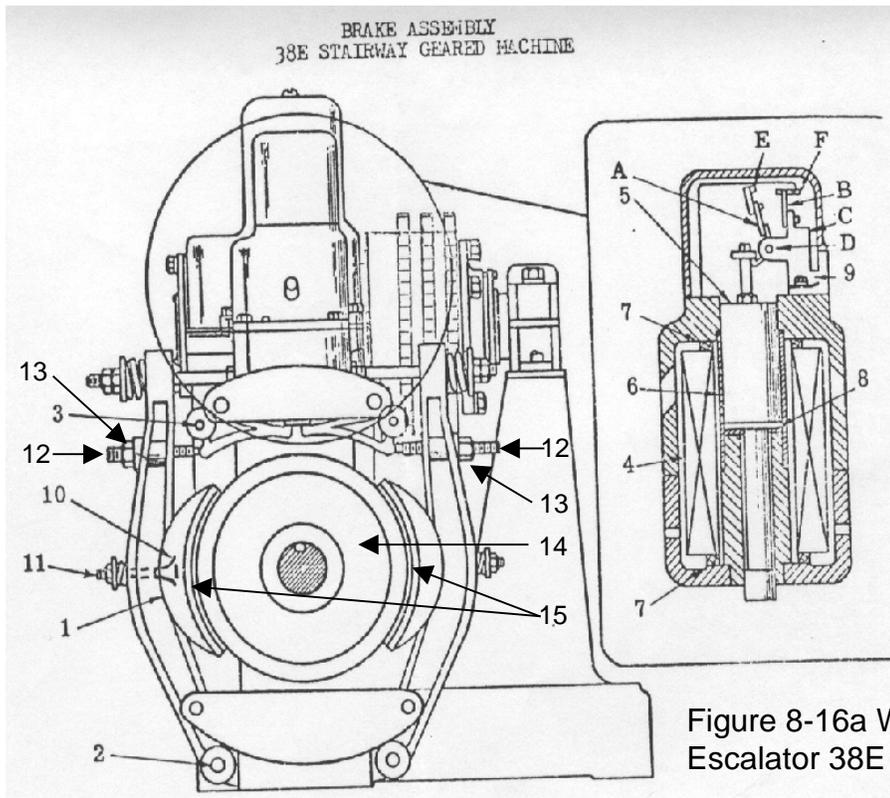
- a) one foot from the skirt switch to the combplate.
- b) seven inches from the skirt switch to the combplate.
- c) the distance from the location of the switch to the combplate.
- d) the distance from the location of the skirt brushes to the combplate.

101. What action should you do if you found a Westinghouse escalator stopping distance in the down travel to be more than 8 in. at 120 fpm?

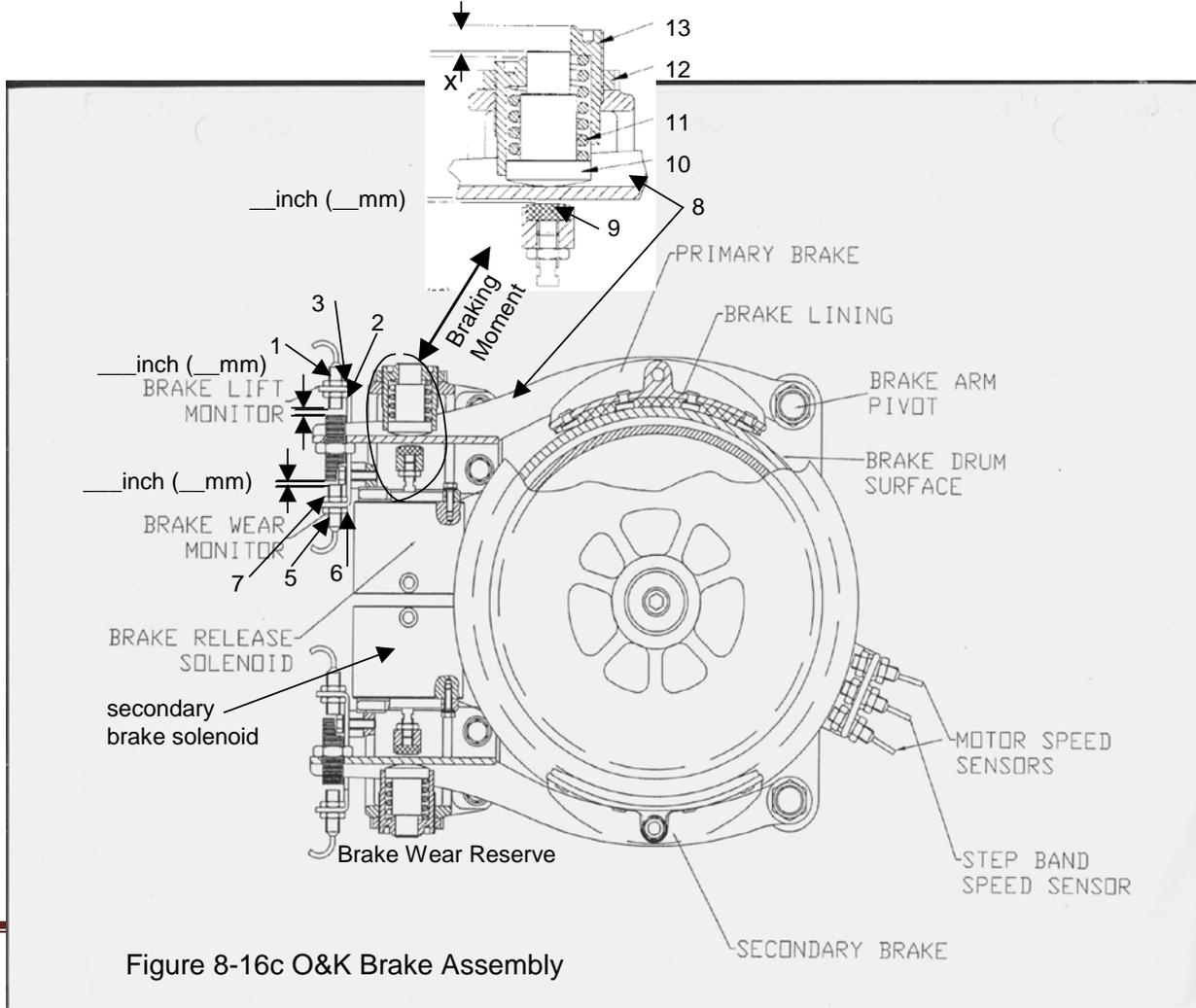
- a) Adjust the brake plunger to 3/16 in.
- b) Adjust the brake spring tension to 1 ½ in.
- c) Make a report to your Foreworker for brake pad replacement.
- d) Inspect the main drive chain for slack to be no more than ½ in. from taut.

102. What part numbers in figure 8-16a requires lubrication.

- a) 1 & 2
- b) 2 & 3
- c) 2 & 13
- d) 3 & 13

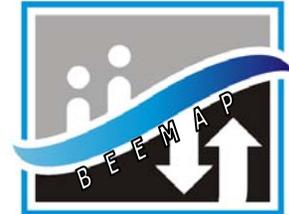


103. You should replace the brake pads in figure 8-16a above when the lining is ___ or less than the original thickness.
- a) 1/3
 - b) 1/4
 - c) 1/2
 - d) 2/3
104. Which brake engages first in figure 8-16c in page 13?
- a) Primary brake
 - b) Secondary brake
105. What is the brake wear monitor gap setting in figure 8-16c?
- a) 5/64 in. (2mm)
 - b) 1/16 in. (1.6mm)
 - c) 3/32 in. (2.3mm)
 - d) 9/64 in. (3.4mm)



106. What is the brake lift monitor gap setting in figure 8-16c above?
- a) 5/64 in. (2mm)
 - b) 1/16 in. (1.6mm)
 - c) 3/32 in. (2.3mm)
 - d) 9/64 in. (3.4mm)
107. What is the minimum brake lining thickness of an O&K escalator?
- a) 5/64 in. (2mm)
 - b) 3/32 in. (2.3mm)
 - c) 1/8 in. (3mm).
 - d) 9/64 in. (3.4mm)
108. How many brakes are there in an O&K escalator with dual machine?
- a) 1
 - b) 2
 - c) 3
 - d) 4

San Francisco
Bay Area Rapid Transit District



Elevator & Escalator Mechanic
Apprenticeship Program

Performance-Based Learning Series

Module 8: Escalator Preventive Maintenance

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300 Lakeside Drive, Oakland, CA 94612
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Module 8: Escalator Preventative Maintenance (PM)

About this Module

The goal of the Escalator PM is to prevent the failure of equipment before it actually occurs. PM is a schedule of planned maintenance actions aimed at prevention of breakdowns and failures. It is designed to preserve and enhance equipment reliability by cleaning, inspecting, adjusting, lubricating and replacing worn parts before they fail.

Why you need to know?

As an elevator / escalator mechanic, it is critical that you develop your expertise relating to Preventative Maintenance. You will need to correctly perform the established procedures to complete scheduled periodic maintenance.

Module Objective

Upon completion of this module, participants will be able to:

1. Apply all safety procedures while performing PM on escalators.
2. Clean, inspect, adjust, lubricate and replace worn components while performing scheduled maintenance procedures.

3. Accurately complete all appropriate documents that confirm the completion of scheduled PM.
4. Apply all code requirements relating to maintaining escalators and their component.

Module Resources

In the performance of the above objectives, participants will be given the following resources:

- BART PM Card
- BART Elevator/Escalator Quick Reference Sheet
- Standard Issue Elevator/Escalator Tools and Replacement Parts
- Escalator scheduled for PM
- Specific escalator Operations and Maintenance Manual (O&MM) as required.
- Most recent publications of the BART OR&P, M&E Safety Manual Book #343, and the Elevator Industry Field Employee's Safety Handbook.

Course Description

The content of this module is based on information available at the time of its publication. It is not a maintenance procedure instruction for action; it is a training material for escalator preventive maintenance. This handout is not intended to replace any designed Operations and Maintenance Manual (O&MM) or Operations and Equipment Manual (OEM) Specifications for BART escalators nor adequately designed to describe the entire maintenance system of an escalator. Some drawings and/or pictures attached are copied from BART O&MM and pictures taken from BART escalators.

The Escalator PM, BART Basics was developed to assist Elevator/Escalator Training Program for new Trainees and maintenance personnel the necessary fundamentals training to ensure a basic understanding of the escalator preventive maintenance. When words used such as; all, most, mostly, system, or any other similar word, they normally pertains to BART property.

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Unit 13: Governor Overspeed

Unit 14: Directional Safety Device

Unit 15: Main Drive Chain & Handrail Drive Chains

Unit 16: Brakes & Broken Main Drive Chain or Emergency Brake

Unit 17: Novatex Chain Boards for Montgomery & Montgomery KONE

Unit 18: Machine Room, Controller, Drive Motor & Coupling

Final Exam

1. The final written exam for this module is an assessment of the Trainees' knowledge on escalator preventive maintenance and safety devices, their location in the truss and their functions. Set safety devices parameters as required.
2. The final practical exam for this module is a performance of the Trainee to demonstrate how to perform preventive maintenance as per BART Escalator Maintenance Schedule; to safely access an escalator truss, clean, inspect and lubricate escalator parts, run the escalator with a remote control, set parameters as required.

Unit 1: Safety Practices

Safety Practices

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to;

Understand and practice all safety measures when servicing an escalator.

A. General;

1. Safety is the most important key element in performing any PM and services on elevator or escalator.
2. It is everybody's responsibility to insure that safety practices are adhered to the maximum to prevent personnel injury and equipment failure. Attention to safety helps prevent injuries and illnesses resulting from unsafe acts or unsafe conditions.
3. BART OR&P set the rules and procedures for personnel and equipment safety for the District.
4. *The service technician must understand the operation of the equipment and the safety measures required to service this equipment.*
5. Do not work on any equipment unless you understand how the equipment functions and you have been informed of potential hazards.
6. Make sure that the Station Agent and Central Control are notified that a PM or a service will be perform in an elevator or an escalator in the station.
7. Barricades are to be use around the exits and entrances of an elevator or an escalator where a PM or a service will be perform, and/or place Out-of-Service signs in a prominent position to notify all persons that use of the escalator is prohibited. BART Safety Definitions and Requirements Book 217 page A-4 or the latest revision/edition.
8. **Loose fitting clothing, neck chains, rings and watches that may become entangled in moving equipment should not be worn.**

9. **Safety shoes must be worn.**
10. **Eye, ear and respiratory protection should be worn as appropriate for the type of work being performed.**
11. Do not run an escalator on “Automatic Control” when the steps have been removed. Do not inch an escalator by pushing the plunger or the armature of the motor starter. Use a Remote Control or a pendant control.

B. Electrical;

1. **Lockout and tag-out of the main disconnect switch must be perform. After the work has been completed, the lock and tag or tags shall be remove by the same person whose name appears on the tag.**
2. **Dirty, oily, and watery pits or machine rooms are safety hazards. They must be clean before performing any PM or service.**
3. **Ensure that there is adequate lighting in the machinery rooms and pits and especially around moving machinery.**
4. **Extreme caution should be exercised when doing any electrical work. Less than 1 ampere or as low as 12 volts can kill.**
5. Prior to working on any electrical circuits, check for live voltage present.
6. **All electrical circuits must always be treated as live.** All voltages can be dangerous. Contact with even low voltages can result in serious injury.
7. To check a circuit, test the live side with a voltage tester set on a higher range, then test the dead side and retest the live side again. This action ensures the good condition of the voltage tester.
8. As a general rule, use only one hand for switching. Keep the other hand clear. Before closing a switch, make sure that a circuit is ready and all moving parts are free, personnel near moving parts are notified that the circuit is to be energized and proper fuses are installed.

9. When using a temporary circuit jumper, make sure that you understand what effect the jumper have on the elevator or the escalator. Always remove your jumper when job is finished or before leaving the job site.
10. Before starting an escalator, make sure no bystanders have entered around safety barricades at either end of escalator. Notify all personnel working in or around the escalator that the unit is ready to start. Wait for their reply before starting.

C. Escalator Inspection

Some inspections may require side panels, steps removal, and replacement or repair of defective or worn parts.

Reinstall removed side panels, steps or any other component.

After inspection, cleaning, adjustment, parts replacement/repair, and before returning the unit to service, run the escalator to check for normal operation.

Inform the Station Agent and Central Control of the escalator status.

Report to your Foreworker or Supervisor all deferred maintenance and safety related repairs that need immediate action.

Holding the key operated switch to UP or Down for longer than 9.6 seconds will trigger a starting fault.

MMI (Man Machine Interface) at the upper landing newel provides similar display as the Programmable Logic Control (PLC) in the logic control box for all Otis, Montgomery and Westinghouse escalators features are;

- **Fault display** - can view 16 most recent faults/events with dates & time.
- **Status mode** - displays the status. Example, "Not running ready to run".
- **Single arrow** - Down/Up used to scroll to the previous fault.
- **Double arrow** down - view 1st recorded fault at the bottom of the list.

- **Reset switch** - will reset the controller logic for the failed safety device and if the safety device has been manually reset as required.
- **Manual resetting** of MMI or controller reset switch maybe required after activation of any safety device.

Unit 2: Importance of Preventive Maintenance (PM)

Importance of PM

Why Is Escalator PM Important? **Once an escalator is placed in service, its parts will start to wear and abnormal conditions may exist that requires constant preventive and corrective maintenance. PM is the care and servicing by personnel for the purpose on maintaining the escalator in satisfactory operating condition by providing a systematic inspection, detection, and correction of parts that may fail or develop into major defects. This protective maintenance will provide safety to the riding public, the maintenance person, and equipment reliability which are all essential. A safe and reliable escalator is a reflection of a properly maintained unit which is a performance result of a well-trained and conscientious mechanic.**

A. What is PM?

1. PM is the most efficient management of materials and equipment exercised to achieve the one overriding consideration in the District establishment --- “The equipment readiness to serve the riding public.”
2. PM is used to minimize the wear and tear and failure of the equipment.
3. When performed properly, it prolongs the life of the equipment. PM also minimizes the unsafe condition that may occur due to parts breakdown.
4. The old saying “if ain’t broke, don’t fix it” is not acceptable procedure for the PM. Scheduled periodicity must be performed to attend best equipment performance.
5. PM reduces complex maintenance to simplified procedures, plans manpower and material requirements, and detects areas requiring additional emphasis on training and techniques.

B. What are the Types of PM?

1. Full maintenance or full service is required on each an equipment. The periodicity of each visit (EV), Bi-weekly (BW), monthly (M),

quarterly (Q), semi-annually (SA), and annually (A), or as recommended by the manufacturer must be performed. These can be accomplished by three inspection methods:

- **Visual awareness review;**
 - **Manual inspection and repair;**
 - **Mid-used or failed part replacement.**
2. “Oil & Lube,” “Oil & Grease,” or “Clean & Lube” are just periodic PM to do necessary lubrication and conduct minor cleaning and inspection. This does not maintain the equipment in a safe operating condition and often result in equipment failure and increase in maintenance cost. Full service inspection methods shall be performed in addition to any adjustment parameter set by the manufacturer.

C. What are the Goals of PM?

1. Minimize personnel injuries. Many injuries and some death come about when an elevator or an escalator fails due to an improper or lack of PM.
2. Minimize the cause of failure therefore it extends the life of the equipment.
3. PM provides the means of gathering information on expenditure of resources in the maintenance of the equipment, failure data, and other data related to the maintenance. Collected data can be displayed and analyzed to show the direct relationship of corrective (repair) maintenance to PM. The elevator/escalator personnel can use this data to improve their maintenance effort.
4. The equipment can provide a reliable and continuous service as required by the users.
5. **Overall benefits are:**
 - **Increased reliability.** PM increases reliability by substituting PM for corrective maintenance.
 - **Increased Economy.** PM reduces casualties and saves the cost of major repairs.
 - **Better Planning.** PM facilitates the efficient and convenient programming of work by advance planning. Inevitable changes in personnel assignments can be accommodated.

- **Better Records.** PM records contain more data that can be useful to the maintenance manager.
- **Improved Leadership and Management.** The increased clarity and convenience of the system, as well as the reduction in frustrating breakdowns and irregular hours of work help prevent “moral breakdowns.” PM also enhances the feeling of effectiveness on the part of the crew and the managers.

D. Objectives of PM: PM is developed to provide the department and its supervisor[s] with effective means to plan, schedule, and control equipment maintenance. PM is designed to:

1. Reduce the complex maintenance of equipment to simplified procedures that are easily identified and managed.
2. Define the PM required, schedule and control its performance, describe the methods and tools to be used, and provide for the detection and prevention of impending casualties.
3. Forecast and plan manpower and material requirements.
4. Plan and schedule maintenance tasks.
5. Estimate and evaluate repair parts readiness.
6. Detect areas needing improved personnel training and improve maintenance techniques.

E. What Type of Lubricants are we suppose to use and why?

1. Proper lubrication is perhaps the most important part of any maintenance program. Lubrication is an important factor in sustaining production, reducing delays, and lowering maintenance cost.
2. Lubricants reduces **FRICTION and WEAR**, carry away **HEAT** from bearings and running parts, aid in sealing against **DIRT**, and protect metal surfaces against **RUST and CORROSION**.
3. The wrong lube used or incorrectly applied, the results can often be worse than doing nothing.
4. **Viscosity** is probably the most important property of oil. Viscosity is a measure of the thickness of oil. The higher the viscosity numbers the thicker the oil.

5. Proper lubrication requires;
 - Using correct lubricant
 - Applying the lubricant in a proper lubricating manner and right quantity.
 - Checking at the proper intervals.

F. How to use BART Escalator Maintenance Schedule (EMS):

NOTE: EMS may change from time to time to conform to the O&M manual of new escalator and/or District Maintenance Control Program requirements.

EMS cards are normally posted in the machine room of the equipment and submitted to your supervisor at the end of the year for record keeping.

1. Upper Rows:

- First row shows EMS with a blank space for the year the PM has to be performed.
- Second row consist of;

The station designation for the escalator, Examples: C60, A90.

Unit # - number designation of an escalator in a location or station, example; P1 in C60 is a platform escalator. This unit # (P1) is always used by the Station Agent in identifying each unit for maintenance or safety inspection request.

District # - The State Inspector, Division of Industrial Safety (DIS) uses the District number for inspection and record keeping. Example; C60/P1 with District # 55838.

- **The third empty line is for the maintenance person name.**

2. First left column is a list of major locations of an escalator;

- **Top Head – list most typical escalator parts or components located at the upper end. Some of these parts may be located in a separate room near the top head and are related to the driving machinery.**

- **Bottom Head** – list most typical escalator parts or components located at the lower end or the lower reversing station (LRS).
- **Steps** – list most typical escalator step parts. These parts may or may not be common to all types of escalators.
- **Top and Bottom** – list most typical escalator parts or components that are common to both the top and bottom ends i.e. safety devices.

3. Second column;

- List most typical escalator parts or components. Some of these parts have the very basic PM procedure to be performed, but it may or may not list all of the equipment of a particular type and model. Use the O&M manual for specific details, parameters, procedures or any additional PM periodicity to be accomplished.
- Using the specific O&M manual is important to perform PM for the following operating and safety devices, if installed but not be listed in the EMS. The O&M manual may list PM cycle to be performed for each visit, annually, and every three years. Clean, inspect, lube, adjust if necessary, and test operate the following for normal operation;

Westinghouse and Fujitec Reversal Stop devices (directional switch).

Handrail Speed Monitoring Device (broken handrail).

Missing Step Detector.

Step Level Device.

Montgomery & Montgomery KONE Access Cover safety device.

Comb-Step Impact Device.

Fujitec and Otis Step Axle Sleeve Bearings.

Montgomery, Fujitec, and Montgomery KONE automatic oiler or gear bucket – clean and refill.

Rolling Shutter Device (security gate) – test operate while escalator is barricaded and running. The escalator will stop upon closing of the shutter/gate.

Step demarcation light – clean cover and replace burnt lamps.

4. Third column are numbers 1 - 4 for PM card CODES as indicated:

1. Check operation, adjust & clean as needed,
2. Lubricate as needed,
3. Check for unusual noise or heat,
4. Check for wear & breakage.

5. Fourth column;

- **List the cycle of the PM to be performed based on the pattern of wear or breakdown of the parts or they may also be SAFETY related apparatuses that requires constant attention. The higher the frequency of wear or parts breakdown justifies the need of shorter PM cycle. The following symbols are used for operating escalator (non-operational or inactive escalator requires less attention);**

Bi-M for PM schedule required every two weeks.

M or MO for monthly or every month.

Q or QR for quarterly or every three months.

S or Bi-A for semi-annually or every six months,

A or AN for annual schedule to be perform every year.

6. Fifth column:

- List of all the months in a year. The maintenance person must enter the date upon completion of PM under that month.
- N/A (Not Applicable) is used when a certain part that does not belong to the type of the escalator being maintained and when the periodicity of QR and Bi-A were not due.

Some inspections may require side panels and steps removal, and replacement or repair of defective or worn parts.

After inspection, cleaning, adjustment, parts replacement or repair, reinstallation of all removed hardware, and before returning the unit to service, run the escalator to check for normal operation.

Inform the Station Agent and Central Control of the escalator status before leaving the station.

BART ESCALATOR MAINTENANCE SCHEDULE 2006; LOCATION : _____ **UNIT :** _____ **DIS #** _____

EMPLOYEE NAME: [For Training Use Only](#)

Enter the date when each item is completed

C O F	ITEM	C O D E	C	J	F	M	A	M	J	J	A	S	O	N	D
	check stopping distance & pad wear	1	M												
	machine room or area		M												
	Check Relays & Tighten hardware	1	M												
	emergency brake operation	1	M												
	al gears, check for wear and lube	1	M												
	box, lube & check seal condition	1	M												

rail condition, clean guides & check rubber tire	1	M																		
rail sprockets & drive chain tension; lube	1	M																		
rail newels & idler bearings	1	M																		
drive chain tension, lube & check length	1	M																		
sprocket tightness on spline	1	M																		
ovatex boards & replace as necessary	1	Q																		
disassemble, clean & adjust	1	Q																		
pillow block hardware & sprockets	3	Q																		
pin lube	1	Q																		
breaker, check disconnect hardware	1	Q																		
governor & Drag switch assembly	1	Q																		
gear box oil	3	S																		
motor coupling	1	S																		

hardware	1	M																	
demarcation strips & Lights	1	M																	
Tabs	1	M																	
ad boards	1	M																	
cover hardware & level of cover to floor	1	M																	
clean pit pans NOTE: Clean O&K oil separators	4	M																	
ail inlets & switches	1	M																	
segments & step indexing	1	M																	
switches & emergency stop buttons	1	M																	
switches	1	M																	
SAFETY STRING Function's (controller & switches)	1	M																	

switches	1	M																	
ell's	1	M																	
gaps, molding, skirt brushes etc...	1	M																	
lead in tracks at bull gear & bottom carriage	1	Q																	
clean down; Test & Inspect	1	A																	

PM Terminology:

Preventive Maintenance. The sum of those actions performed on operational equipment that contributes to uninterrupted operation of equipment within designed characteristics.

Corrective Maintenance. The sum of those actions required to restore equipment to an operational condition within predetermined tolerances and limitations.

Check. A standard procedure to determine if the current operational status of an equipment is within tolerance/limitations of the desired performance standards. When carried out at prescribed frequency, a check is a part of PM.

Related Maintenance Requirements. PM actions to be accomplished prior to, in conjunction with, or after the task to be perform. A maintenance action is classified “related” whenever substantial savings in time can be realized by performing more than one maintenance requirement after the equipment has been opened. Although it is not listed in the EMS, it is normally performed to insure safety and best performance of the equipment.

Deferred Maintenance Action. Consist of maintenance actions that cannot be completed due to department/revenue operations, lack of repair parts, higher priority work, or need of an outside assistance. This action usually places the equipment out-of-service. Whenever a deferred maintenance is requested

through your Foreworker, inform the Station Agent of the status of the equipment.

Manufacturers Recommended Escalator Lubricants

Reference; BART O&M manuals: *Westinghouse Electric Corp, Elevator Div. (WEECO), Otis Elevator Company, Montgomery KONE (MKO), Fujitec America, Inc. (FAI)*

<u>Application</u>	<u>Lubricant/ Specs / Temperature Range</u>	<u>Company Name</u>
Gear Oil	Part Name	
	Med. E.P V=660/990 ----- 19 ^o to 86 ^o .	
	Heavy E.P. V=1420/1705 --- 50 ^o to 120 ^o F, SUS at 100 ^o F	
Reduction	Gear oil/Weeco #8 L.T.	Low Temp Westinghouse
Machine/	Gear Lub/Otis #33	--- OTIS Elev. Co.
Worm Gear	Oil, Worm Gear P-23317	10W-30 Montgomery KONE
	Cosmo Gear SE 150	SE 320 Fujitec Standards
	NL Gear Compound Grade 150	Grade 320 Chevron
	Spartan E.P. Grade 150	Grade 320 Exxon
	Mobil Gear Grade 629	Grade 632 Mobil
	Omala Grade 150	Grade 320 Shell
	Sunep Grade 1060	Grade 1090 Sunoco

=====

Application Lubrication Specifications - Medium way oil ISO grade #68, Viscosity
 Chain Oil sCt 40^o C, Tackiness additive, anti-slick-slip, anti-wear & anti-corrosive, thermal stability additives.

	Lubricant part number	Company Name
Escalator Chain,	IDEMITSU daphine multiway 68 ER	Fujitec Standard (Japan)
Step Axle,	Non-WAY OIL #68	Fujitec Standard (FAI)
Reversal Stop	VISTAC OIL 68 X	CHEVRON
Switch, Lever,	FEBIS K 68	EXXON
Pawl Brake Shaft	VACTRA OIL #2	MOBIL
	TONNA T 68	SHELL
	SUNVIS #768	SUNOCO
	ANTI-LEAK INDUSTRIAL OIL 68	MYSTIK

Application Lubrication Specifications - Extreme pressure multi-service

Bearing Grease. Grease, water absorbing lithium base temperature stable to 100⁰

F.

	Lubricant part number	Company Name
Main Drive, Tension	MOBILITH AW 2 (green)	Fujitec Standards
Carriage, Vertical	DURA-LITH E.P. #2 (amber)	CHEVRON
Diving Machine	UNIREX N #2 (green)	EXXON
Bearings	MOBILITH AW 2 (green)	MOBIL
	ALVANIA 2 (green)	SHELL
	PRESTIGE #742 E.P.	SUNOCO

NOTE: Do not mix one manufacturer's lubricants with another manufacturer's lubricants.

Abbreviation:

ISO	- International Organization for Standardization
SUS	- Saybolt Universal Seconds (or SSU)
V	- Viscosity Range at 100 ⁰ F
AW	- Anti-wear
E.P.	- Extreme Pressure

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Unit 3: Access Cover and Control Switches

CAUTION

Tagout and lockout circuit breaker whenever you access the stepband and while performing maintenance and repair on electrical circuits.

Access Cover and Control Switches

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to clean, inspect and test operate;

- **Key Operated and Emergency Stop switches.**
- **Pit Stop Switches.**
- **Access cover switches.**

A. Inspect Key Operated & Emergency Stop Switches

Lift the guard of an Emergency Stop Switch (figure 8-3) at the lower landing. There should be an alarm bell at the opposite landing to warn passenger riding or entering the escalator.

Push the emergency stop button. An up or a down traveling escalator will stop smoothly.

Clean the surfaces of the emergency stop switch (figure 8-3a p4) and directional key switches (figure 8-3).

If evidence of water or contaminant entry onto the switch is visible, open and expose the switch contacts and terminals. Clean, inspect and make sure that all fasteners are secured, no corrosion around the contacts, and no water or any contaminants are inside the switch box. Secure all cover hardware to avoid any contaminant entry.

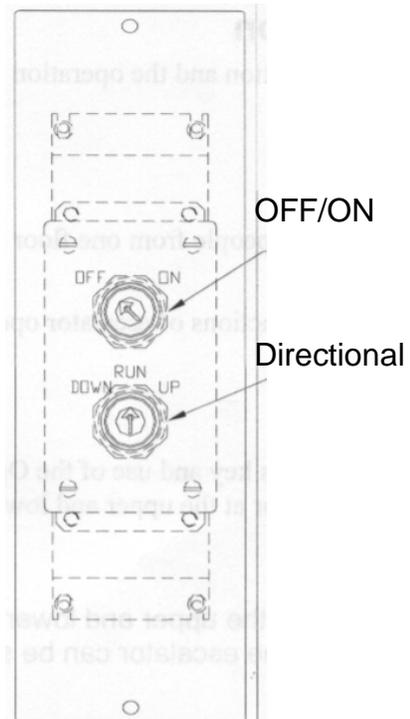


Figure 8-3 Fujitec Directional Key Switch (operator panel)

Test all functions of the switch to be working. Replace worn or defective parts.

Perform the same procedures at the upper landing for the similar switches.

Figure 8-3a

Correct any failed subsystem of the escalator.

B. Pit Stop Switches and Maintenance Pendant (Remote Control) Safe Operation

Turn OFF and inspect the pit disconnect/inspection/service switch or pit stop switch. The safety circuit must open and the unit must not run if any of the key operated or the remote control switch were turned on.

Different manufacturer have different control switches designs but they all functions the same, to safely run and to stop the escalator when any of the safety circuits opens or the power fails.

NOTE: The Maintenance/Normal switch inside the Mid-American Escalator Controller must be placed on MAINTENANCE position prior to the use of the Remote Control / Inspection Control.

Verify that when the pit stop switch (figure 8-3b p5) is turned to OFF/STOP, **the unit will not start at all** by performing the following:

- Turn the directional key switch to UP, wait for couple of seconds. The unit will not start. The DOWN travel switch should function the same.
- Plug in the Remote Control. Turn it ON to start the escalator, once in UP and once in DOWN. The unit will not start.

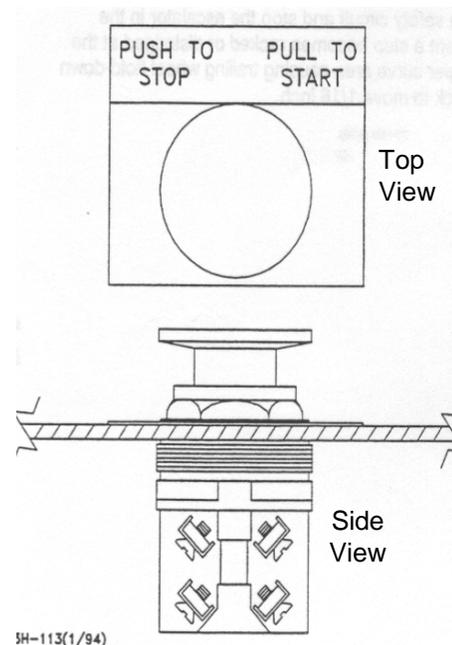


Figure 8-3b Montgomery KONE Pit Stop Switch

Turn the pit stop switch to ON / Inspection and test the Remote Control operation (figure 8-3c).

Run the unit in the UP travel, STOP then run it in the DOWN travel. The unit shall stop whenever you take you hands off the switch. If not, inspect the switch for wear or defect.

NOTE: Only one Remote Control can be attached at a time.

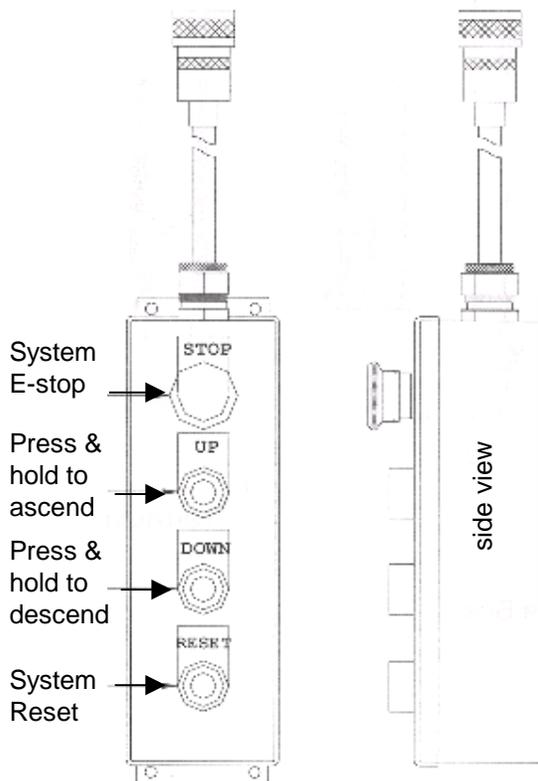


Figure 8-3c Fujitec Maintenance Pendant (Remote Control)

Perform the same operation at the upper landing and motor pit stop switch upon completion of all preventive maintenance required at the LRS.

NOTE: O&K Inspection/Remote Control, when in use, you must reset key operated switch after the remote control is plug in.

C. Clean, Inspect and Test Access Cover Switches. Montgomery and Montgomery KONE (figure 8-3d below)

Remove and reinstall access cover plates with care not to damage the access cover switch plunger and switch adjustment.

Insure that the landing plates are reinstalled to their original position to actuate the switch plunger.

To perform any escalator service with the access cover plates removed, bypass the Access Cover switches with a "C" clamps or similar tools pressed against the switch plunger to maintain the switch closed.

- Remove access cover plates and test run the unit. The unit must not start.
- Clean and inspect access cover switches.
- Perform procedures below for adjustment.

ACCESS COVER SWITCHES

Perform the following to adjust access cover switches.

The access cover switch is located on the left hand side of the pit and is tied into the upper end junction box. Make sure the access cover switch will shut down the escalator when actuated before performing any service, maintenance and repair procedures.

1. Barricade both ends of the escalator.
2. Remove access covers, and turn mainline disconnect OFF.
3. Loosen microswitch mounting screws (1).
4. Place a straight edge (2) above the microswitch (3), and across adjoining floor.
5. Adjust microswitch so actuator (4) is located 3/16 inch [5 mm] below straight edge.
6. Tighten microswitch mounting screws.

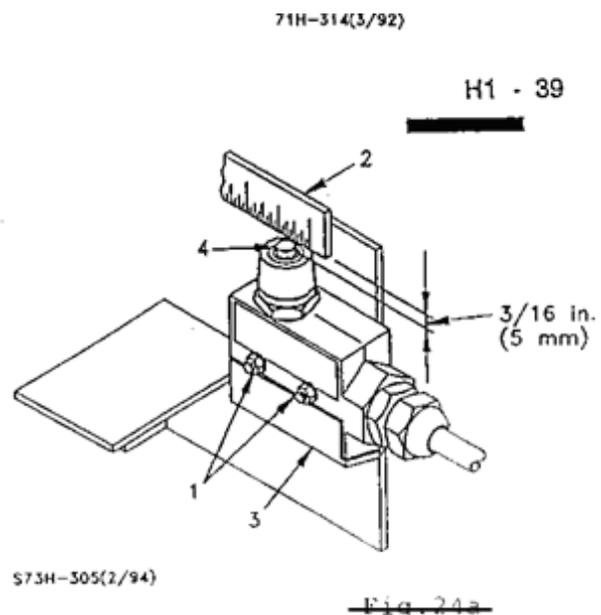


Figure 8-3d Montgomery KONE

Practice Questions: Write your answer and name in a separate paper.

1. Can the Remote Control Switch function when the Pit /Stop switch is turned OFF?
 - a) Yes
 - b) No

2. Which of the following BART escalator has an access cover switch?
 - a) Otis
 - b) Fujitec
 - c) Montgomery
 - d) Westinghouse

3. Which of the following is the “Dead Man Switch.”
 - a) Pit stop
 - b) Emergency stop
 - c) Remote control
 - d) Key operated switch

4. Which if the following the lubricants does not do to the equipment?
 - a) Seal against dirt.
 - b) Carry away heat.
 - c) Reduces friction and wear.
 - d) Provides rust and corrosion.

5. What is the preventive maintenance cycle in inspecting bull gear pillow block hardware and sprockets?
 - a) Monthly
 - b) Quarterly
 - c) Semi annually
 - d) Annually

FIELD PRACTICAL, SKILL TEST, Perform

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

- 1. Inspect Access Cover switch. Test run observe the escalator with opened access cover.**

- 2. Plug in the Remote Control. Test operate and observe the escalator with the pit stop switch OFF. Test remote control to run the escalator with the pit stop switch ON.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 4: Handrail and Handrail Parts

CAUTION

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Handrail and Handrail Parts Inspection

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform cleaning and inspection of the handrail;

- Speed monitoring device.
- Overall condition
- Tension and normal operation for passenger safety.
- Inlet switches & speed sensor.
- Guide tracks and guide shoes behind side panels.
- Lubricate handrail drive chains.
- Drive chain tension sprocket.

A. Inspect Handrail Condition

NOTE: **Handrail-Speed Monitoring Device** will cause the activation of the alarm whenever the speed of either handrail deviates from step speed by 15% or more and it will stop the unit if it is ON for more than 2 seconds.

Barricade and ride the escalator.

Hold both handrails upon entering into the escalator step entrance to check handrail lead/lag and if they run at the same speed as the steps.

For passenger safety, you will observe that your grips on the handrails should move slightly ahead of you during travel and more just before exiting the step.

Use table 1 below (Fujitec O&MM, Book 103, Section 7) to check for lead or lag to be within a specified allowance.

Table 1 **Handrail-to-Step Lead or Lag Allowance by Rise**

Rise in feet	Allowance value in inches	
<u>Height (ft)</u>	<u>Lead</u>	<u>Lag</u>
13	6 in.	0
16	7.5 in.	0
19	9 in.	0
22	10.5 in.	0
25	12.0 in.	0
29 and up	13.5 in.	0

If the handrail lags behind the steps by more than allowable distance, stop the unit and check the number of teeth on the handrail drive system sprockets and the diameter of the handrail drive sheave. Check for wear of the handrail drive sheave. Use the O&MM for the correct equipment size or compare it with the same escalator type and height.

The need to change grip on the handrail more than once during a single level rise would indicate a need for further internal inspection. Lagging handrail may have;

- Worn handrail drive sheave traction tire on Westinghouse and Fujitec PS-ST 1200 escalators. Traction tire should be **no less than 2/3 of the original thickness**. Traction tire should be **above the shoulder of the sheave groove**. Fujitec traction tire must not have any head of tire mounting screws exposed to the handrail interior.
- Improper handrail tension. Check handrail tension rollers (figure 8-4) and all hardware for wear and proper operation. Replace worn parts. Inform your Foreworker the need to replace handrail.
- Check and adjust take-up device of a Fujitec escalator (figure 8-4 below) if handrail lags behind the step.

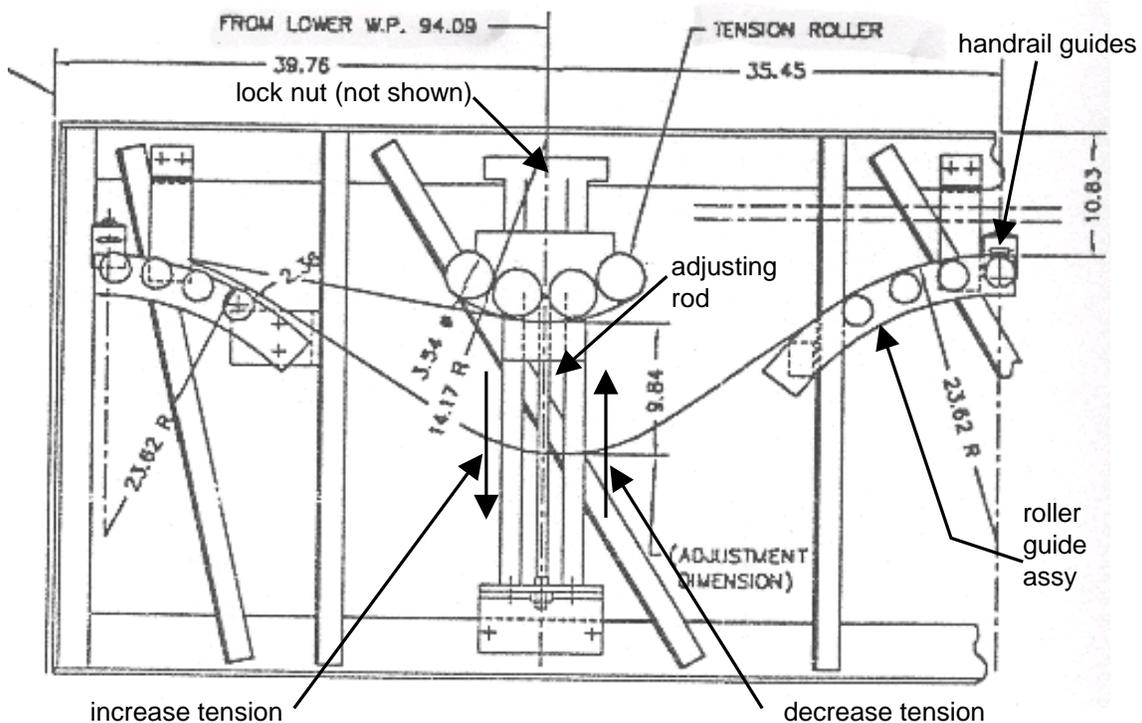


Figure 8-4 Fujitec Handrail Tension Device

B. Inspect Handrail Condition

1. Check the handrail appearance;

- With the escalator stop, mark one location on each handrail with chalk.
- Inspect each handrail through a complete revolution.
- Look for the following that would be **hazard to passengers** or may trip the handrail inlet switch;
 - **Cuts** - look for outside cuts, if more than $\frac{1}{4}$ **inch wide**, make a report to your Foreworker for replacement.
 - **Cracks** - look around vulcanized or spliced area.
 - **Peeled-Off** - look either outside rubber or inside ply cloth. Any rust or rubber filings present on the balustrade deck indicates that an internal inspection of the handrail system may be warranted.
 - **Bubble gum** - scrape off and clean with cloth soaked in ethyl alcohol.
 - **Run the escalator** to clean grease or dirt off the handrail.

Wipe away off dirt with slightly wrung cloth soaked in the neutral detergent, or apply rubber cleaner liquid to a cloth. Completely wipe the handrail surface with a dry cloth until completely dried.

2. Check and observe handrail while riding;

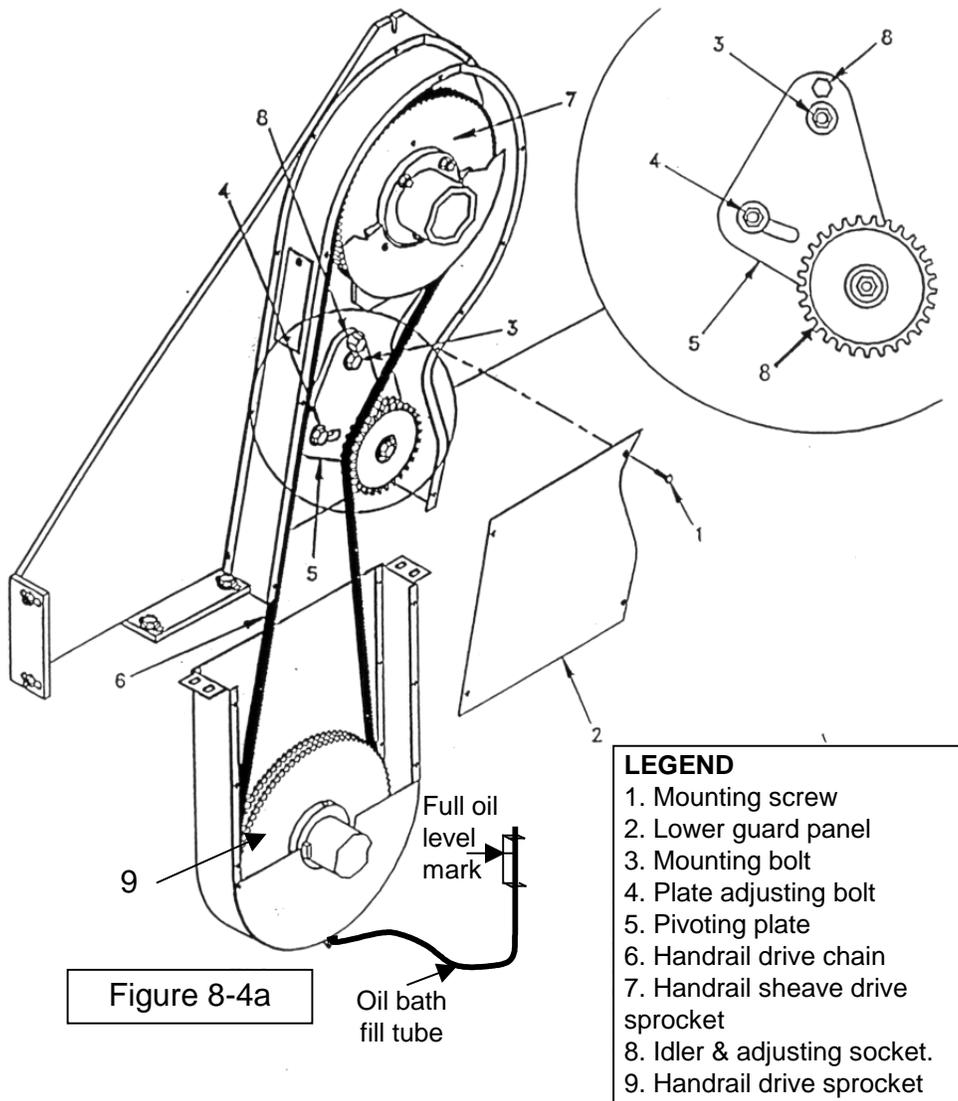
- Operates with an uneven, wavy motion and vibration, or snaking,
- Runs with any unusual noise. Further inspection is required.
- Feels warm with bare hand.

If handrail operates with an **uneven or wavy motion and “snaking”** from left to right or easy to pull out of the guide, it may be due to **worn canvas** or shredding of the interior structural reinforcements, **worn guide tracks**, poor casting or splices. Inspect the inside of handrail for wear and tear.

If the handrail operates with **vibration**, inspect handrail drive sprocket (item 9 figure 8-4a p6 loose or worn drive chain, excessively tight drive chain or lack of lubrication, loose or worn idler sprocket (item 8).

Inspect handrail drive and drive sheave sprockets, chain for proper lubrication, idler bearing for wear, and secured mounting bracket.

HANDRAIL DRIVE CHAIN (BI-WEEKLY PM)
(MONTGOMERY KONE)



Check oil bath level mark if equipped and refill every two weeks. In the absence of oil bath, manually lubricate the chain.

If handrail feels warm, it may be dragging or slipping against drive sheave, the guides behind side panels, or the handrail inlet may be tight. Investigate the source and resolve the problem.

3. **Listen or feel any grinding noise** from the handrail that may indicate;
 - Wear and tear of bearings, rollers, or defective handrail parts,
 - Handrail may jumped off its idler or track guide behind the side panels,

- Handrail rubbing against the balustrade deck lips around the newels as indicated by residue of rubber fillings around the newel.

C. Check Handrail Tension and Normal Operation

Run the escalator in the down direction to check the handrail stopping force or handrail tension.

If available, use a spring force gauge with a handrail clamp (f/f part no.795 by Fujitec) at the top landing.

If spring force gauge is not available for measuring handrail tension, run the escalator in the down travel to;

- **Check handrail tension by grabbing hold of the handrail with one hand at the top of the upper newel.** Avoid prolong stopping of handrail not to activate handrail speed sensor.

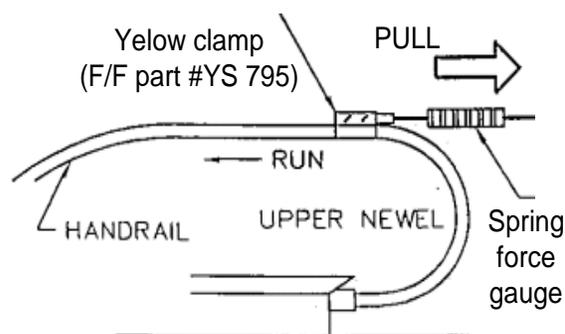


Figure 8-4b Measuring Handrail Tension

To avoid injury, make sure that you have proper footing and grab a hold of the handrail momentarily. If the handrail stalls, an alarm must activate immediately, and after not more than 15 seconds, power must be removed from the driving machine and the brake.

- The handrail should lightly slip with a hard pull. High rise escalator handrails may resist any pull or slip.
- If handrail does not slip slightly or if it's too loose, adjust handrail tension idler or check for worn parts.

Check the handrail underside (figures 8-4c & 8-4d p8. The underside should be close enough to the handrail stand or base.

- **The horizontal clearance between either lip of the handrail and the handrail stand shall not exceed 10 mm (0.375 inch) ASME A17.1.**

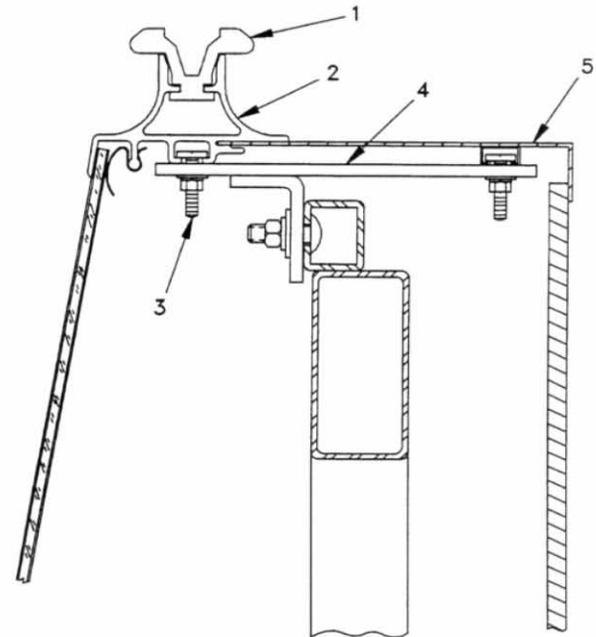
If a wide gap exists between the handrail stand and the undersides of the handrail, check for worn-out guide or tracks. Replace worn tracks.

HANDRAIL BASE

Following is a typical example of removing and replacing procedures for the lower straight section of *handrail base*.

1. Barricade escalator, and remove access covers.
2. Turn mainline disconnect OFF.
3. Remove curve and first straight inner panel.

For more information on removing inner panels, refer to SKIRTS & INNER PANELS/Removing & replacing procedures/Inner panels.
4. Peel handrail off handrail guide (1). Start at the lower end, then the lower curve, and up past the joint on handrail base (2) being removed.
5. Remove handrail guide from base. To remove, pull handrail guide straight out end of escalator over the top of newel assembly.
6. Loosen T-bolts (3) which secure handrail base to deck brackets (4).
7. Turn T-bolts (3) in channel of handrail base sideways to allow removal of handrail base.
8. Tilt top of handrail base back toward outside of escalator, and pull bottom of handrail base up towards inside of escalator to slide handrail out from deck (5).



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CAUTION: Personal injury could occur when handling sharp-edged decks. Be careful when removing handrail base.

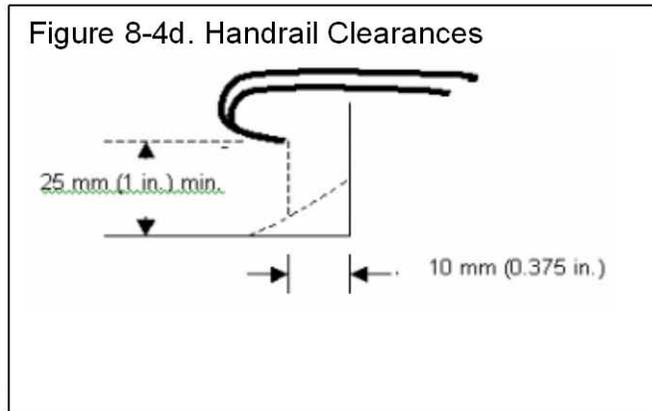
Figure 8-4c ; CHECKING THE UNDERSIDE OF THE HANDRAIL (MONTGOMERY KONE)

9. File joints of new handrail base to obtain a hairline crack at each joint.
10. Insert new handrail base in place.
11. Turn T-bolts (3) back in channel to secure handrail base, and tighten.

Make sure there are no burrs or sharp edges. File to remove any burrs or sharp edges.
12. Slide handrail guide back into place.
13. Replace handrail and inner panels.
14. Turn mainline disconnect ON, and replace access covers.

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Figure 8-4d. Handrail Clearances



The vertical gap between the handrail and the adjacent surfaces shall be 1" (figure 8-4d) except when a rounded fillets or beveled sides of the handrail stands are permitted to reduce the 1" clearance between the handrail and the point where the handrail stand is connected to the balustrade.

Due to wear of tracks and handrail canvas, pay attention to vertical gaps (figure 8-4d p8) between handrail and handrail base at the;

- **lower transition** - a wider vertical gap will expose the sharp metal edges of the balustrade upper deck,
- **upper transition** - a narrower vertical gap may create pinch area between the track and handrail or the handrail and the balustrade upper deck.

Check the handrail stand (item 2 figure 8-4c p8 and balustrades upper deck (item 5) splices and joints for smooth even surfaces. There should be no gaps between splices and joints.

Pull handrail from track/guide to **clean and vacuum** foreign materials from track channel. Inspect all track hardware to be secured.

Insure that there are no exposed sharp metals from the balustrade top deck.

Access, clean and inspect handrail drive sheave, return sheave, and idlers behind the side panels.

Grab the sheave on opposite end to check for side-to-side slop caused by wear of the shaft, bearing and bearing housing. If an excessive side-to-side slop is found, repair or replace defective part.

Lubricate **sheave bearings** and all pivot points of the guides. Clean spilled lubricant or grease spilled.

Detach the handrail from the tracks to access the upper and lower rollers at the newel of the Fujitec PS-ST 1200 escalator.

Clean and inspect the condition of the sheaves or newel rollers (Fujitec PS-ST 1200 handrail newel rollers figure 8-4e) for wear, poor rotation, noisy and worn bearings. Insure that the handrail inside lining is not riding over the guide roller housing edges, molding or framework.



Figure 8-4e Fujitec Escalator Handrail Guide Rollers

Replace each roller guide assembly when evidence of roller wear is noted.

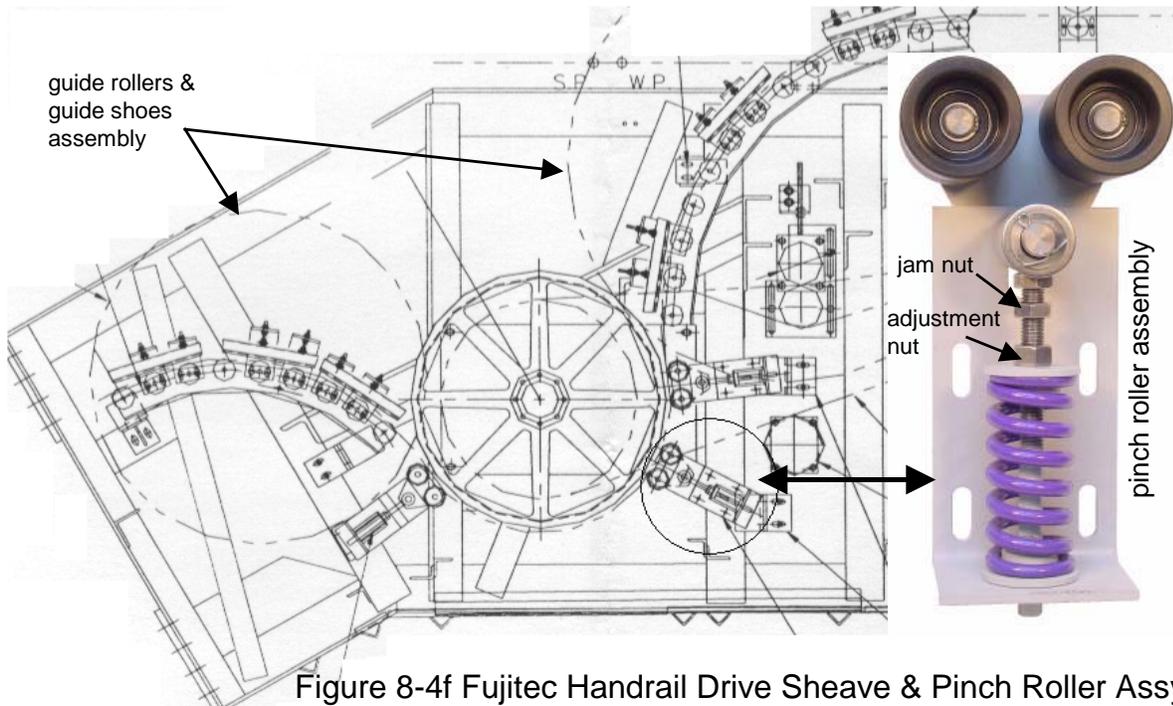


Figure 8-4f Fujitec Handrail Drive Sheave & Pinch Roller Assy

Inspect Fujitec Handrail Drive Sheave and Pressure Rollers Assembly

- Remove 8 steps and move missing steps to access handrail drive, guide shoes and guide rollers assembly.
- Clean and inspect pressure or pinch roller for wear. Replace rollers in set.
- Set spring tension of the pressure roller to **3 1/5 in.** – standard value.
- Inspect the handrail drive sheave rubber traction. Replace rubber traction if less than **2/3 its original thickness or the rubber screws heads are exposed against the handrail canvas.**
- Clean and inspect handrail rollers and guide (figure 8-4g). Insure that all rollers are not worn and the handrail rides on the rollers and guides squarely. Set the distance between the handrail guide and roller to 10mm.

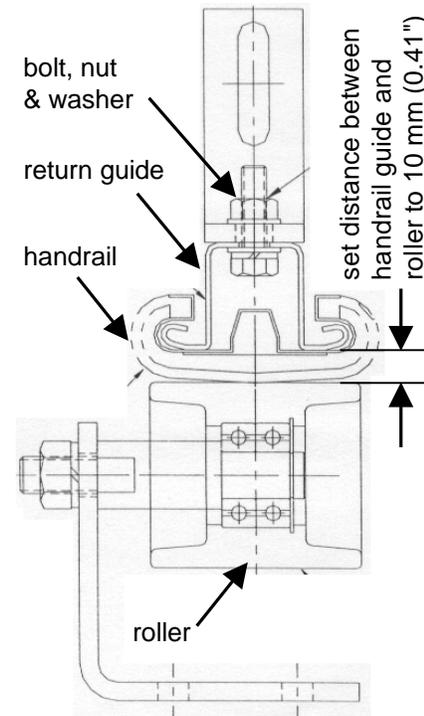
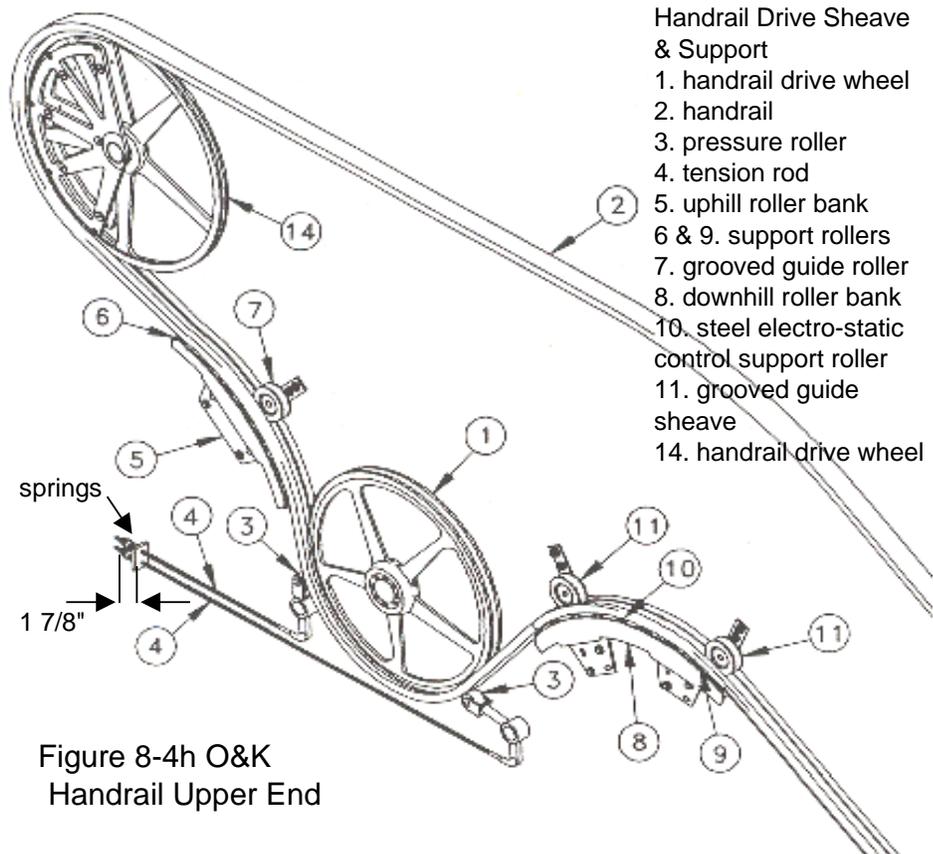


Figure 8-4g Fujitec Handrail Roller & Guide

O&K LH and RH Handrail Drive Sheave and Pressure Roller Assembly;

- Remove five steps at the top landing and move missing steps to access handrail drive sheave and pressure roller assembly at the upper incline.
- Remove side panels at the upper landing to clean and to inspect the upper newel drive wheel (item 14).
- Inspect newel (item 14) and drive wheel (item 1) bearings. Grab and shake

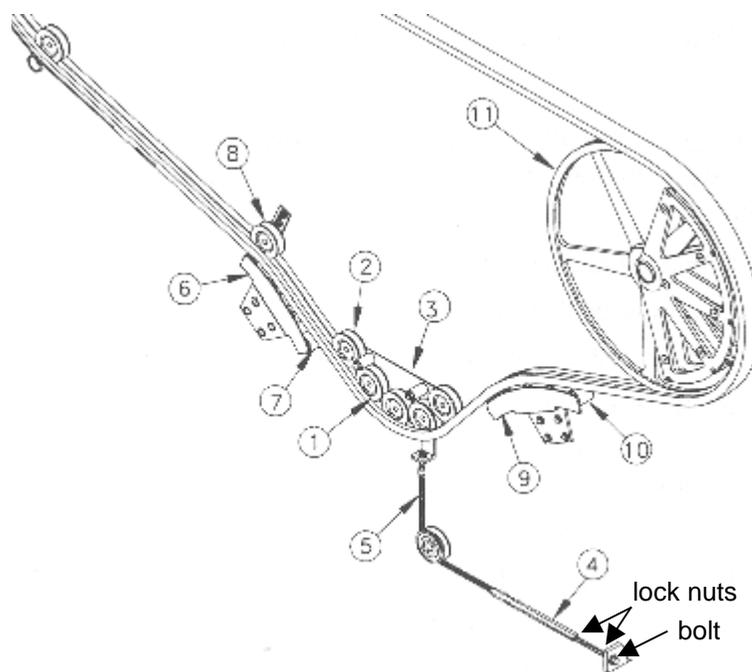


opposite ends of the wheel. If an excessive side-to-side slop is found, replace defective parts. Lubricate handrail drive sheave bearings.

- Clean and inspect all handrail support rollers (items 5 & 8), pressure and V-groove rollers (items 7 & 11). The handrail should be riding the guide rollers squarely. Rollers should be free to spin and not worn.
- Clean and inspect the pressure rollers (item 3) for tension. Adjust **springs to 1 7/8 in.** to maintain handrail tension on the drive wheel (1). Replace both rollers when one is worn. If pressure rollers were replaced, run the unit for one revolution to check the setting of the handrail against the drive wheel. The handrail should not sag below the drive wheel. In the event the handrail speed deviates from the step-belt by more than 20%, a warning signal sounds for about 2 seconds. After 2 seconds, the escalator will stop.

Inspect Handrail Tension Device (figure 8-4i) at the lower landing.

- Move missing steps above the handrail tension device at the lower end.
- Remove side panels to access and to clean handrail newel wheel. Lubricate and inspect the newel bearings.
- Clean and inspect all rollers and guides. The rollers should not be worn. The guides should contain the handrail in place and not worn.
- Remove handrail from guide and observe handrail tension. The handrail section removed from the guide should run straight over the balustrade curve. Loosen nuts in front of rod (4) and behind the mounting bracket, then adjust bolt to correct handrail tension.
- Clean and inspect adjusting rod and chain for corrosion. Lubricate the



**Figure 8-4i O&K
Handrail Tension Device**

1. handrail tension device
2. V-grooved rollers
3. roller mounting plate
4. adjusting rod
5. chain
- 6 & 9. bank of support rollers
7. four flat support rollers
8. V-grooved guide roller
10. five support rollers
11. handrail newel wheel

threaded ends of the adjusting rod with drop of oil. Vacuum guide tracks. Reinstall handrail back and run the unit in down direction. The handrail must not leave the guide.

Determine that all four hand or finger guards/handrail inlet safety devices are present where the handrail enters the balustrade. Clean all surfaces around the moving mechanism of the safety guard.

Clean, manually activate, and check each **handrail entry safety device** for normal operation. When actuated, a running escalator will stop and will not start until the switch is reset manually and the controller reset switch is cleared. Check all clearances between the handrail and the guard. Adjust and reset each activated switch if necessary.

Check that all guards are in good condition and properly sized to prevent fingers or hands from being drawn into the newel.

O&K Handrail Inlet Sleeve (figure 8-4l). Clean, inspect, lubricate pivot points and

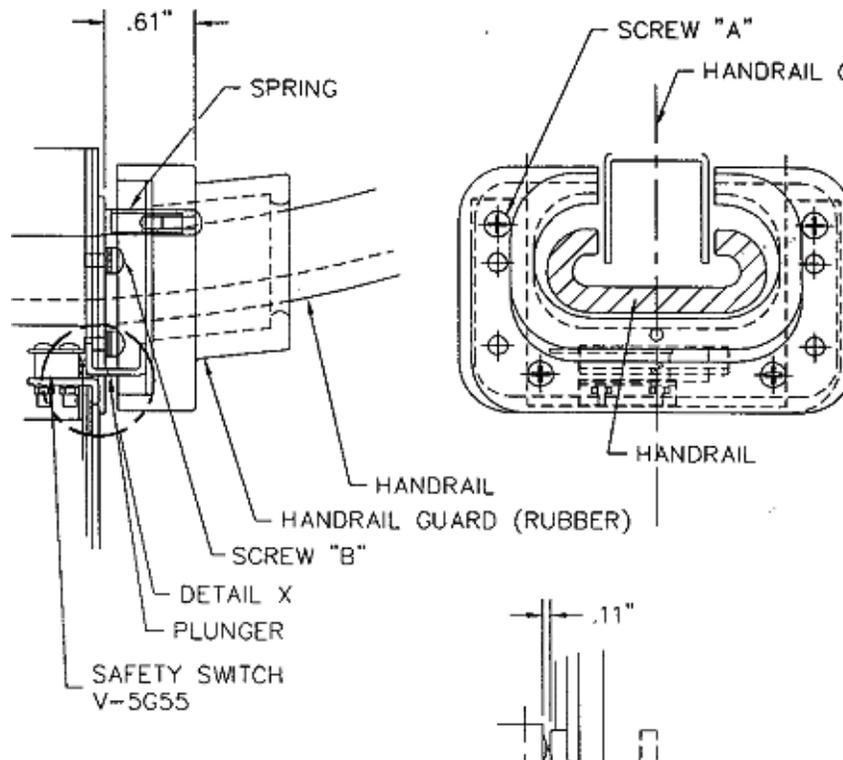


Figure 8-4k Fujitec Handrail Inlet Device

adjust if necessary. Check for damaged inlet sleeve. Replace if damaged.

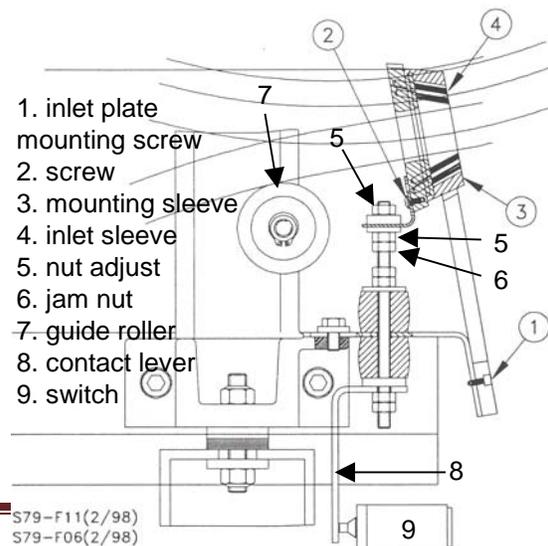


Figure 8-4l O&K Handrail Inlet Sleeve

Inspect handrail clearance through the inlet sleeve. Adjust if necessary.

Check the operation of lever and switch by pushing the inlet sleeve (4). The lever should move by **1/8 in.** to actuate the switch. The unit must not start. Reset controller.

Check the guide roller (7) for wear and all hardware to be secured. Replace if necessary.

Montgomery KONE Handrail Inlet Device (figure 8-4m). Clean and inspect free opening of windows. Push windows inward to actuate the switch. The unit must not start. Reset controller. Lubricate window hinges with drop of oil.

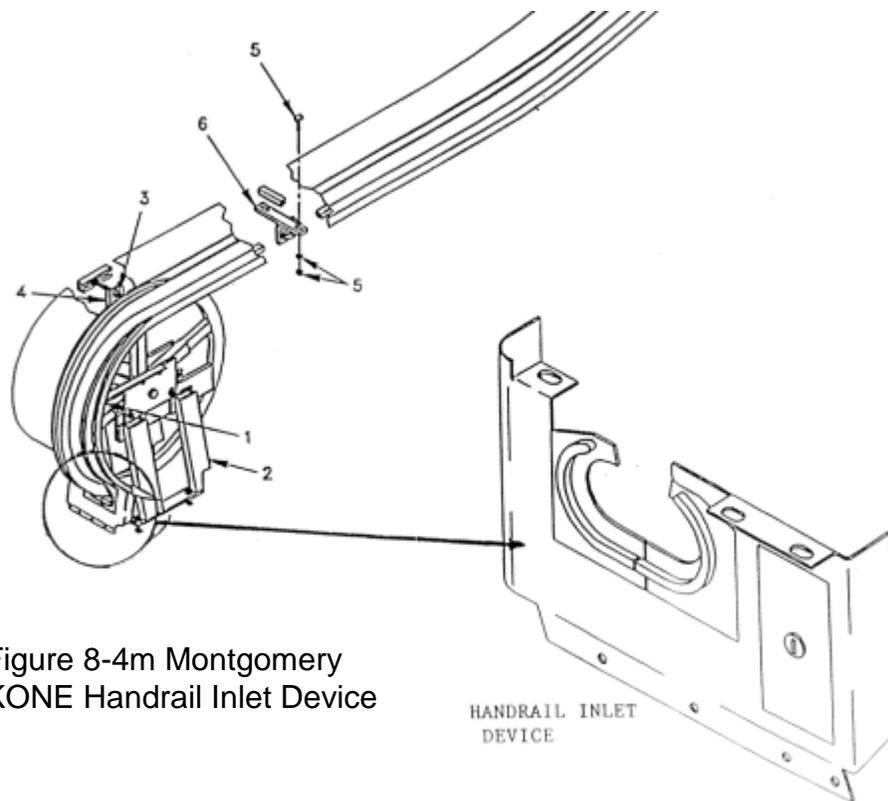


Figure 8-4m Montgomery
KONE Handrail Inlet Device

Removing & replacing procedures

HANDRAIL INLET SWITCHES

Complete the following to remove and replace handrail inlet switches.

1. Barricade both ends of the escalator.
2. Remove access covers.
3. Turn mainline disconnect OFF.
4. Remove end inner panel to gain access to handrail inlet switch (1) behind frontplate (2).

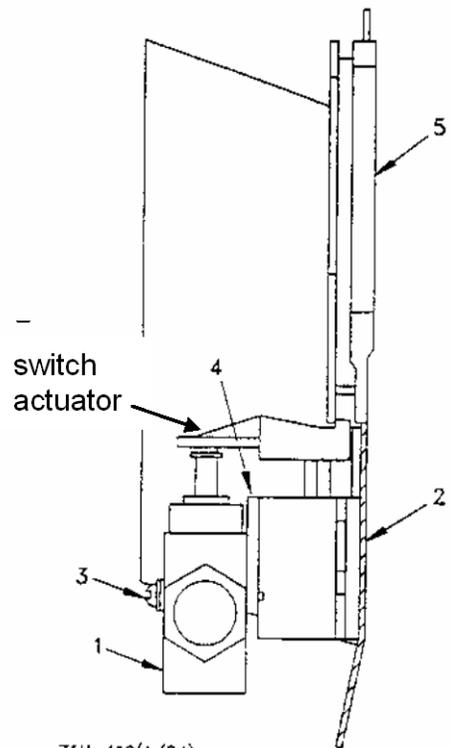
For more information on removing inner panels, refer to SKIRTS, DECKS, & INNER PANELS/ Removing & replacing procedures/Inner panels.

5. Remove switch mounting screws (3) from microswitch (1) and mounting plate (4).
6. Remove microswitch, and remove wires.
7. Wire new switch and insert switch on mounting plate.

For more information on wiring a microswitch, refer to Removing & replacing/Microswitch wiring, in this chapter.

8. Position handrail inlet switch to actuate when inlet doors (5) are opened.
9. Insert switch mounting screws, and tighten.
10. Replace end inner panels and access cover.

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Figure 8-4n MKO Handrail Inlet Sw.

Montgomery KONE Handrail Inlet. Reset the switch actuator of the Montgomery KONE escalator by pulling and closing the inlet doors back in place with a thin L-shape puller or similar tool. Reset the MMI or fault sensor in the controller.

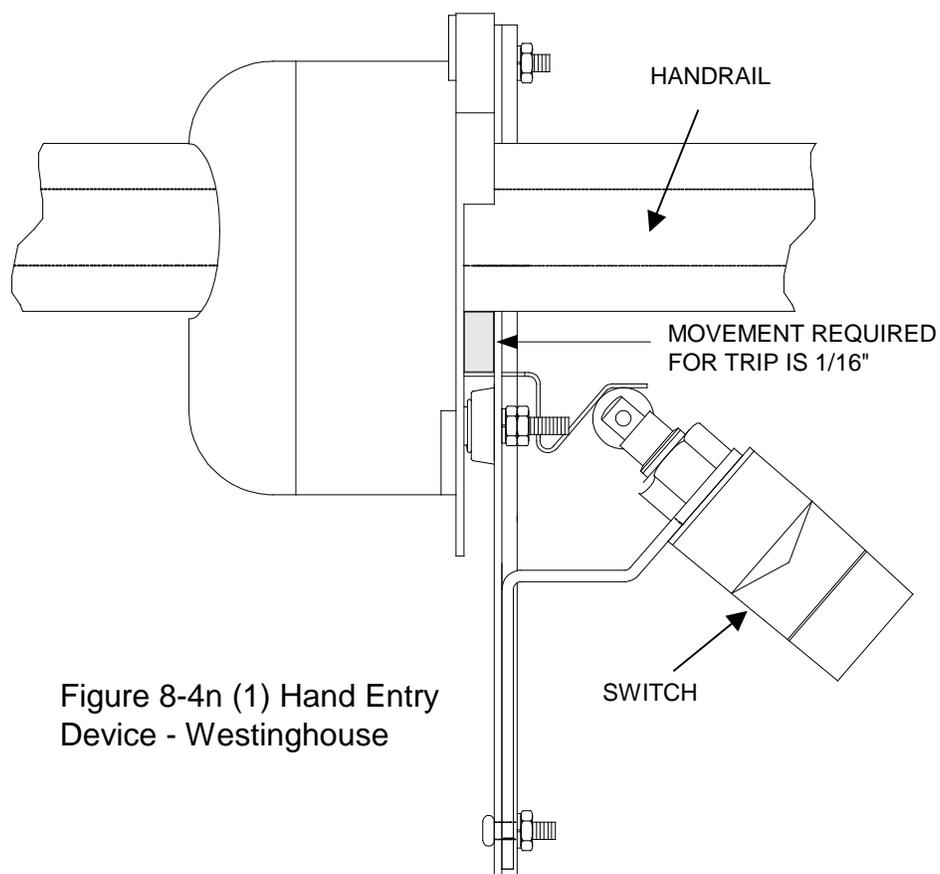


Figure 8-4n (1) Hand Entry Device - Westinghouse

Westinghouse Handrail Entry Device.

Clean and inspect Westinghouse hand entry device. Insure that the actuator is set to actuate the switch when **1/16 in.** movement is achieved. Adjust if necessary.

Fujitec Broken Handrail Device (figure 8-4o for Model PS-S 1200 & figure 8-4p for Model PS-ST 1200).

- PS-S 1200 (figure 8-4o). Locate the speed sensor at the upper landing near the newel. Dismount the digital speed sensor away from the pulser disk that turns with the roller underneath the handrail. Verify if it works, test run the unit. The unit should not run. The handrail speed device at speed zero is interpreted as a broken handrail. The switch has upper and lower set points to stop the escalator at $\pm 5\%$ of the nominal handrail speed.

Clean the disk, the digital speed sensor, and the roller. Set the clearance between the digital sensor from the pulser disk at 9.5 mm ± 3.2 (0.37 \pm 0.13). Reinstall sensor.

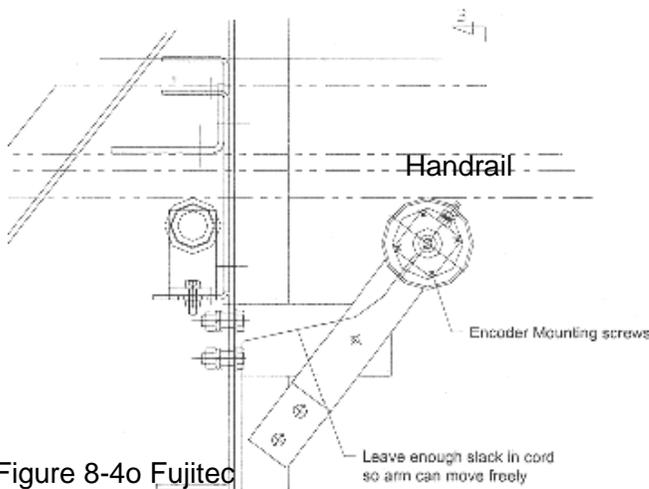


Figure 8-4o Fujitec PS-S 1200 Handrail Speed Device

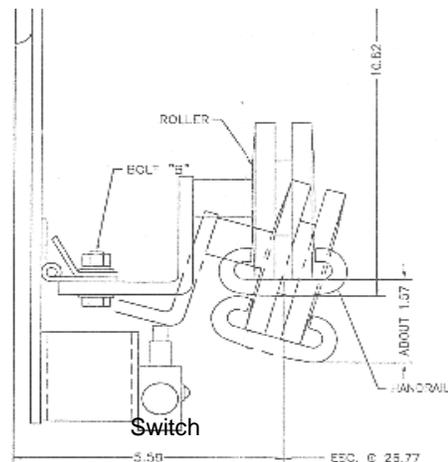


Figure 8-4p Fujitec PS-ST 1200 Broken Handrail Device

- PS-ST 1200 figure 8-4p. Clean, inspect and test operate the **broken handrail device** located at the lower incline 110 inch from the lower working point (WP).

Loosen the roller assembly mounting bolt (figure 8-4p) to actuate the switch. The unit should not run. Manually reset the controller Reset switch.

Inspect all hardware and fasteners for wear and tear. Replace worn parts. Reinstall sensor and its bracket. Reset the fault sensor.

O&K handrail speed monitor and **broken handrail monitor** (figures 8-4q & 8-4r respectively) are located at the upper transition near the drive machine.

- Figure 8-4q – clean and manually spin contact roller (item 1) and inspect all hardware of the pulse initiator (item 2) for wear. Replace worn roller with pulse initiator assembly.
- Figure 8-4r – actuate the switch by moving the lever (item 1) away from the switch. The unit should not start without resetting the reset switch.

NOTE: Due to outside weather exposure of BART O&K escalators,

Figure 8-4q O&K
Handrail Speed Monitor
1. contact roller
2. pulse initiator

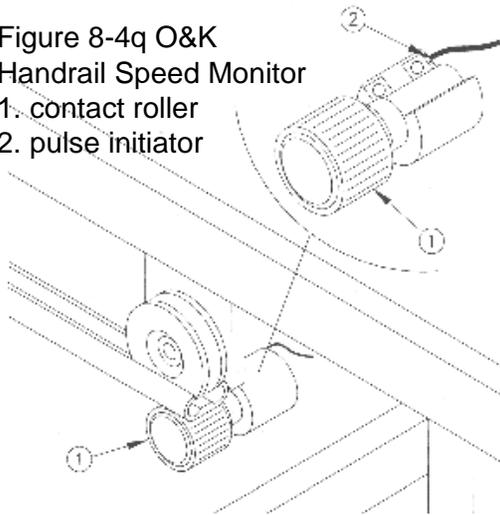
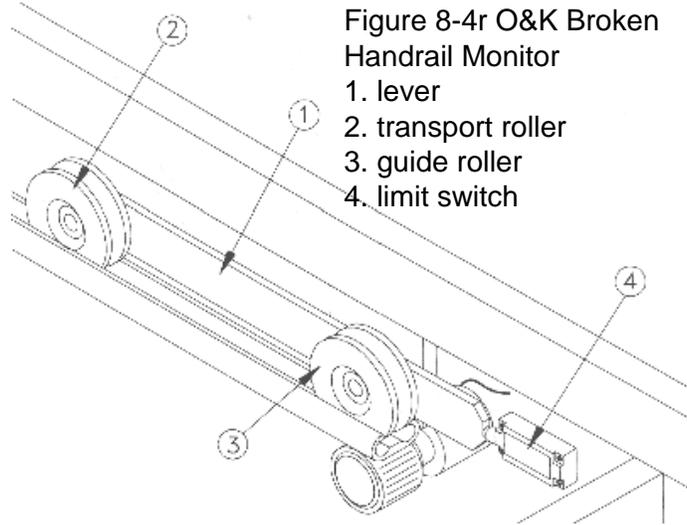


Figure 8-4r O&K Broken
Handrail Monitor
1. lever
2. transport roller
3. guide roller
4. limit switch



the speed and broken handrail monitors require often detailed inspections.

- Inspect the switch housing and connectors for corrosion and water contamination. Actuate switch and listen to a clicking sound. If evidence of corrosion and/or water contamination is present, replace switch.

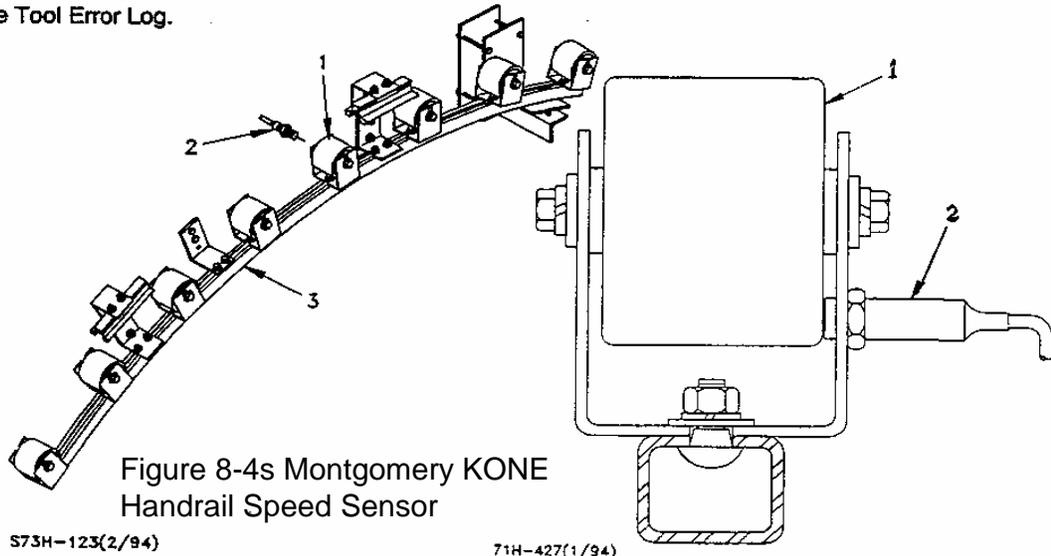
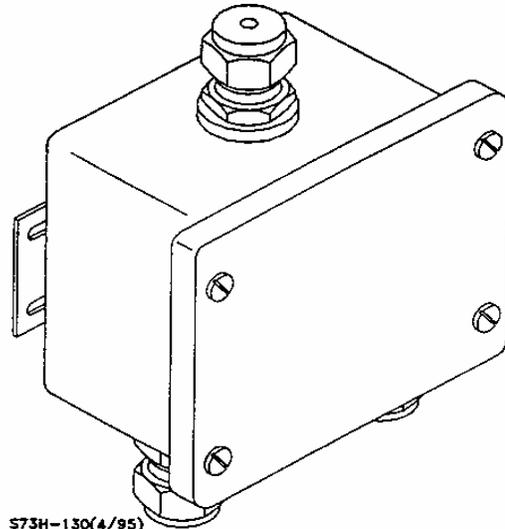
HANDRAIL SPEED SENSOR

The handrail speed sensor uses a roller (1) with 12 steel pin pick-ups and a 12 MM inductive proximity sensor (2). The handrail speed sensors are located on the long handrail take-up device (3) on each side of the escalator.

The splitter box is the tie point for the encoder and handrail speed sensors to the controller. Both the left and right handrail speed sensors plug into the splitter box. The signals from the handrail speed sensors are combined with the encoder signal and are sent to the controller through one cable.

If the handrail speed slows by 5 percent to 15 percent for longer than 10 seconds, a 5 percent error is recorded in the Service Tool error log. The escalator will continue to run.

If handrail speed varies +/- 15 percent in comparison to step speed, a two second buzzer sounds. If this error persists, the escalator will shut down. The error is then recorded in the Service Tool Error Log.



Montgomery KONE handrail speed sensor (figure 8-4s above).

Remove top landing LH and RH side panels to access handrail speed sensor.

Clean and inspect and roller (items 1 & 2) at the long handrail take-up device in the upper incline.

Clean roller and monitoring surfaces of the proximity sensor. Manually spin, listen and check for wear of bearings. Insure all fasteners are secured. Replace worn parts.

Montgomery, Otis, and Westinghouse renovated escalators.

Have access to the handrail speed sensor located behind the spokes of the return sheave.

Clean the monitoring surface of the magnetic sensor and the sheave spokes. Check all hardware to be secured. Observe the sensor for proper operation as follows;

- **1/8 inch** - distance between magnetic sensor surface and spokes.
- A slipping handrail is detected if the elapse time between spokes increases above **.8 seconds** for Westinghouse and **.9 seconds** for Montgomery.
- A handrail slippage is detected if spoke stops in front of the sensor for more than **1 second**.
- An out of speed condition must exist for at least **2 seconds** with a total of **4 seconds** before it shuts off. An alarm bell will ring for **3 seconds** then the escalator will stop and the fault latches until reset is pressed.

Remove side panels to inspect guide tracks or shoes and rollers for wear.

- Ensure that the handrail rides centered onto the roller surfaces, tracks, guides and/or shoes.
- Inspect Westinghouse handrail guide shoes and idlers, idler bearings behind the side panels for wear. Lubricate bearings and clean spilled grease.

Reinstall



Figure 8-4t Handrail Guide Shoe
Montgomery

side



Figure 8-4u Fujitec
Handrail Guide Track

panels and steps.

E. Lubricate and Inspect Handrail Drive Chains

CAUTION: Trip and tagout the quick disconnect switch.

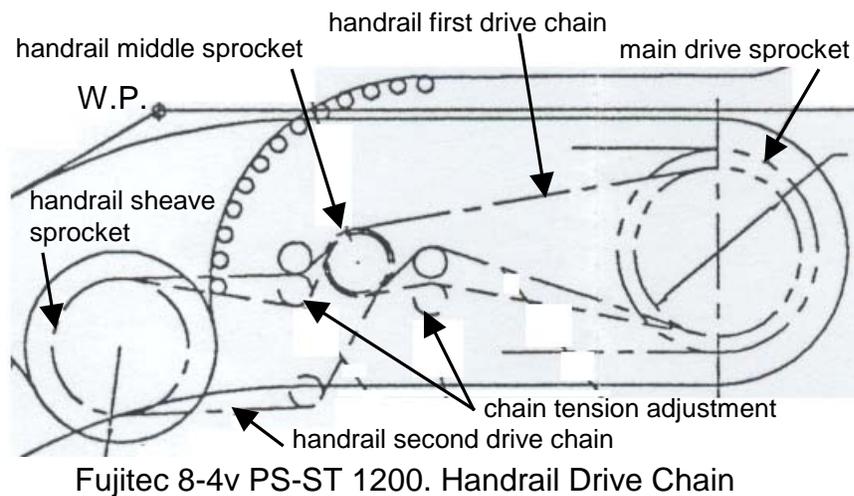
Never take your eyes away from the tip of the manual oiler while oiling if the machine is running.

A bi-weekly oiling of all escalator chains is required for all outdoor and street units as per the O&M manuals.

A monthly oiling of all escalator chains is required for all indoor or platform and units with automatic oiler.

Oil sufficiently but avoid oil dripping to any escalator parts exposed to passengers. Replace oil absorbent and clean oil drip. Dispose of oil absorbent in proper disposal area.

Access, inspect and lubricate Fujitec PS-ST 1200 escalator **number one** and **number two** handrail drive chains (figure 8-4v below) at the upper incline.



Lubricate sleeve bearing of handrail middle drive shaft for the **non-reversing switch** (figure 8-4v above).

Replenish oil inside the oil tank every two weeks. Avoid leaving tank empty to protect the pump motor from burning or drying of seals.

Remove three steps to access the handrail drive chains at the upper incline. Inspect the following;

- **Check chains monthly.** Insure they are receiving proper lubrication. Adjust timer setting as per O&MM if necessary.
- Proper lubrication of the handrail drive chains from the automatic oiler. If found to be lacking lubricant, manually lubricate all handrail drive chains.
- Automatic oiler brushes wear and tubing kinks or leaks. The brushes should be barely touching the chain. Replace worn brushes.
- **Clean brush tips** to remove lint and dirt. Make sure that the brushes are perpendicular to the chain surfaces. Brushes must just touch chain surfaces and not be crushed against the chain.
- **Examine the oil discharged** onto the chains. Adjust the oil flow through the nozzle or through the manifold if necessary. Excessive oil discharge and improperly adjusted nozzle may drip oil onto the steps.
- Inspect oil filter inside the oil tank. Replace if dirty. It must be inspected semi-annually and replace annually.
- **Check battery** for memory power if equipped. Replace every 10 years.
- **Check chain tension.** Adjust chain tensioner if necessary according to the type of the escalator.
- Chain tension; run the unit five steps up then run it down until the open step band is above the handrail chains. Measure the slack and adjust chain idler if necessary. Replace worn chain.
- Sprocket teeth wear, chain meshing with the sprockets, chain rollers are inside the grooves squarely and not riding on top of the sprocket teeth.
- Metal fillings underneath the sprockets. If metal filings are found, locate, investigate the source and correct the problem.
- Idler sprocket teeth and its bearing. The idler should not wobble. Tighten all fasteners.

HANDRAIL DRIVE CHAIN (BI-WEEKLY PM)
(MONTGOMERY KONE)

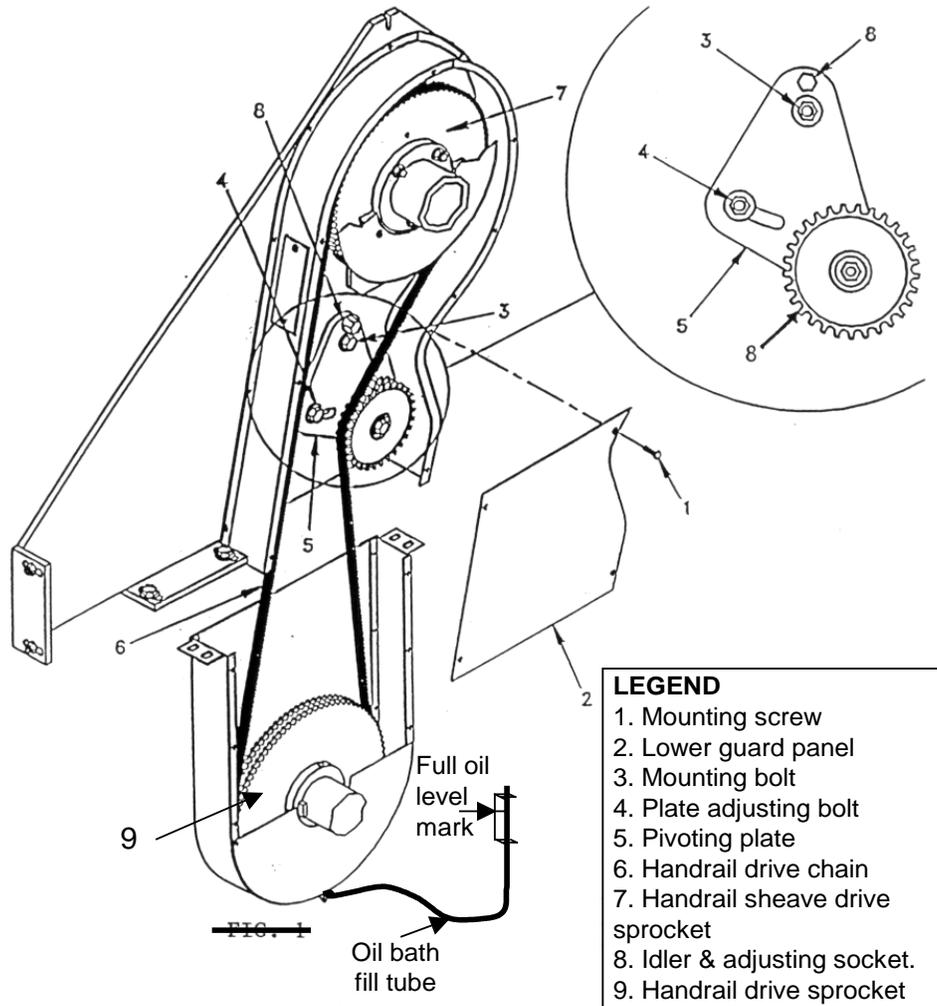


Figure 8-4w Montgomery KONE Handrail Chain

Access LH and RH Handrail Chains of Montgomery, Montgomery KONE (figure 8-4w) and Westinghouse Escalators.

- Remove top landing LH and RH side panels to access handrail chains.
- Clean and lubricate handrail chain. Inspect handrail sheave sprockets and chain tension. Run the unit to move taut chain at the idler side.
- If adjustment is required, run the unit to move slack to the idler side. Inspect idler sprockets and bearing. The idler should not wobble.
- Adjust idler to tension the chain by snugly loosening mounting bolts of the pivot plate. Handrail chain must have some slack when tensioned.

REVIEW QUESTIONS: Write your name and answer in separate piece of paper.

1. *How do you determine the lag/lead of a handrail?*
 - a) Holding the handrail at the top landing on a descending escalator.
 - b) Observe the handrail drive chain for lead or lag.
 - c) Ride the escalator and hold the handrail to check for lead or lag.
 - d) Mark the handrail with chalk and compare the speed with the steps.
2. *How long can you stall the handrail before the power is removed from the driving machine when checking for handrail tension?*
3. *BART escalator handrail speed sensors for Westinghouse, Montgomery, and Otis are located where?*
 - a) At the end of the motor shaft
 - b) Behind the upper handrail sheave spokes.
 - c) Behind the lower handrail sheave spokes.
 - d) Near the lower handrail tensioner.
4. The minimum allowable thickness of rubber traction for handrail drive sheave of Westinghouse escalator _____ of its original?
 - a) 2/4
 - b) 2/3
 - c) 2/5
 - d) 1/3
5. The horizontal clearance between the lip of the handrail and the handrail stand shall not exceed _____ inch?
 - a) .373
 - b) .357
 - c) .375
 - d) .385
6. Where is the handrail idler for Fujitec PS-ST 1200 located?
 - a) upper incline
 - b) lower incline
 - c) mid-section
 - d) top landing

FIELD PRACTICAL SKILL TEST, Perform;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

- 1. Access Westinghouse escalator LH and RH handrail chains to;**
 - Inspect drive sheave bearings and drive sprockets for wear.**
 - Inspect idler sprockets and bearings for wear.**
 - Lubricate and inspect chain tension.**
 - Inspect and adjust chain idler.**

- 2. Access Fujitec escalator model PS-ST 1200 and perform the same as above. In addition, perform inspection to the following;**
 - Lubricate both primary and secondary handrail chains.**
 - Lubricate bearings of the middle shaft sprockets. Clean and drop oil to middle shaft sleeve bearing of the NRO safety device.**
 - Make adjustment to the handrail idler around the drive sheave.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

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Unit 5: Skirts to Step Clearance, Skirts, Decks, & Inner Panels

CAUTION

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Always clean inner panel surfaces before installing suction cup to avoid accidental panel slippage.

Always ride the escalator behind the steps opening. Insure that you have proper footing on the step with a positive grip on the handrail.

Skirts to Step Clearance, Skirts, Decks, & Inner Panels

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to inspect; skirt to step, and panel to panel clearances;

- Determine the proper gaps between skirts and steps.
- Locate skirt obstruction switches and adjust if necessary.
- Determine the proper gaps between each side panels.

A. Skirt to Step Clearance Inspection

CCR, Title 8, Article 13, Escalators. The clearance on either side of the steps and the adjacent skirt guard shall be not more than **1/4 inch** and the sum of the clearances on both sides shall be not more than **3/8 inch**.

Loaded Gap Between Skirt and Step. The clearance (loaded gap) between the step tread and the adjacent skirt panel not more than 5 mm (0.2 inch) when a 110 Newton (25 lbf) is laterally applied from the step to the adjacent skirt panel. The load shall be distributed over an area no less than 3 inch² and no more than 6 inch².

Manufacturers recommend skirt to step clearances or step lateral gap for BART escalators;

Otis - 1/16 inch (1/16 mm)

O&K - 5/32 inch on one side or 9/32 inch on both sides together

Fujitec – 1/16 inch

Montgomery KONE – 1/16 inch (1/16 mm)

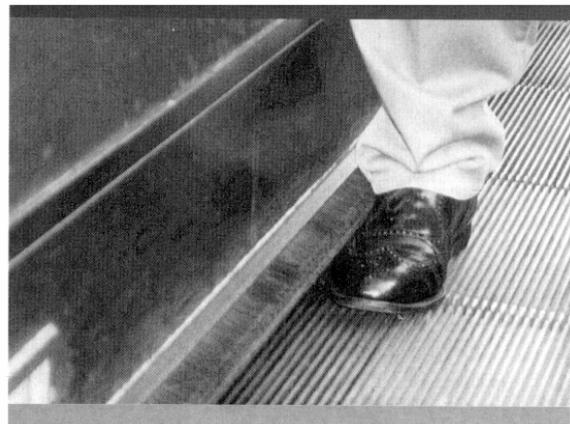
Montgomery - 3/16 inch

Westinghouse – 1/16 to 1/8 inch

CCR Title 8, Article 26. §3126.2. Verify that the rigid mounting assembly (figure 8-5) for the brushes (brush carrier) affixed to the skirt panel shall project no more than **3/4 in.** from the balustrade skirt surface. Inspect the brushes for wear. Replace worn brushes.

Remove side safety brushes and two steps to inspect step to skirt clearance. Run

Escalator Side Safety Brush Figure 8-5



the escalator in the up travel to inspect both LH and RH clearances.

NOTE: Fujitec Model PS-S 1200 do not require a Master Reset switch in the controller
You can restart the escalator from the operation panel after the obstruction has been removed or the problem has been cleared.

Verify a **1/16 in.** typical gap is maintained between the skirt panel and the side of the step. Adjust the skirt panel if necessary.

Adjusting procedures

The following sections describe the adjusting procedures for:

- Skirts, inner panels, & trim
- Step & skirt clearance

SKIRTS, INNER PANELS & TRIM

1. Examine for loose or missing trim fasteners (1).
2. Tighten any loose fasteners, and replace any missing fasteners.
3. Periodically spray skirts (2) with protective spray guard.

STEP & SKIRT CLEARANCE

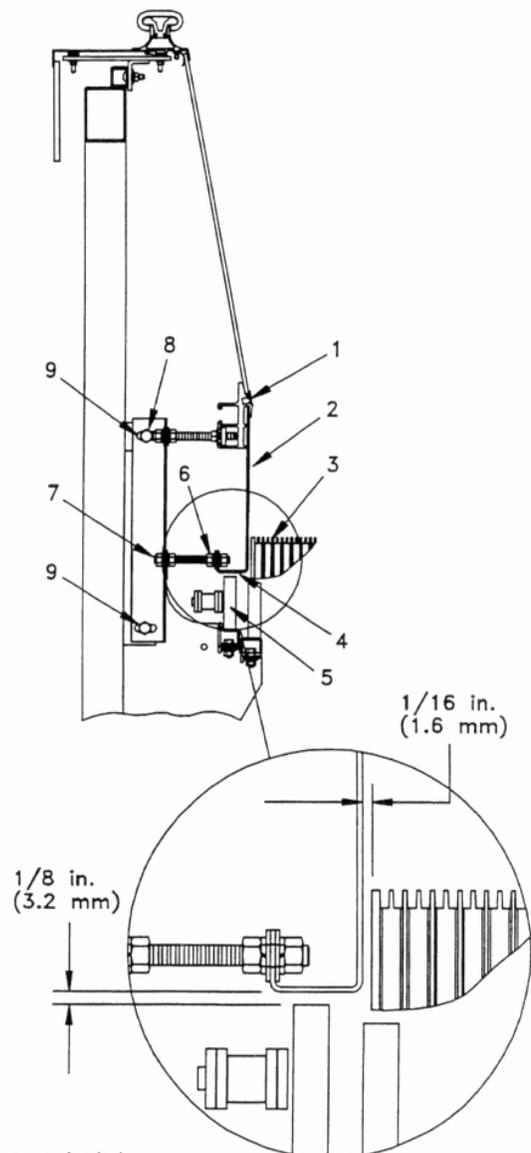
Skirts must maintain a clearance of 1/16 inch between the step tread (3) and skirt (2) on both sides of the step. Also, there must be 1/8 inch clearance between the skirt bottom edge (4) and step roller (5). To adjust for these clearances, perform the following procedure.

1. Barricade both ends of the escalator.
2. Remove access covers.
3. Turn mainline disconnect OFF.
4. Remove trim and inner panels from skirt section to be adjusted.
5. Loosen nuts (6) on threaded rods (7) of skirt brackets (8), and adjust rods in or out to achieve 1/16 inch clearance.
6. Measure distance between bottom edge of skirt and step roller. If skirt clearance must be adjusted, loosen skirt bracket mounting bolts (9) and adjust skirt bracket and skirt.
7. Replace trim and panels.

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Figure 8-5a Skirt to Step Clearance

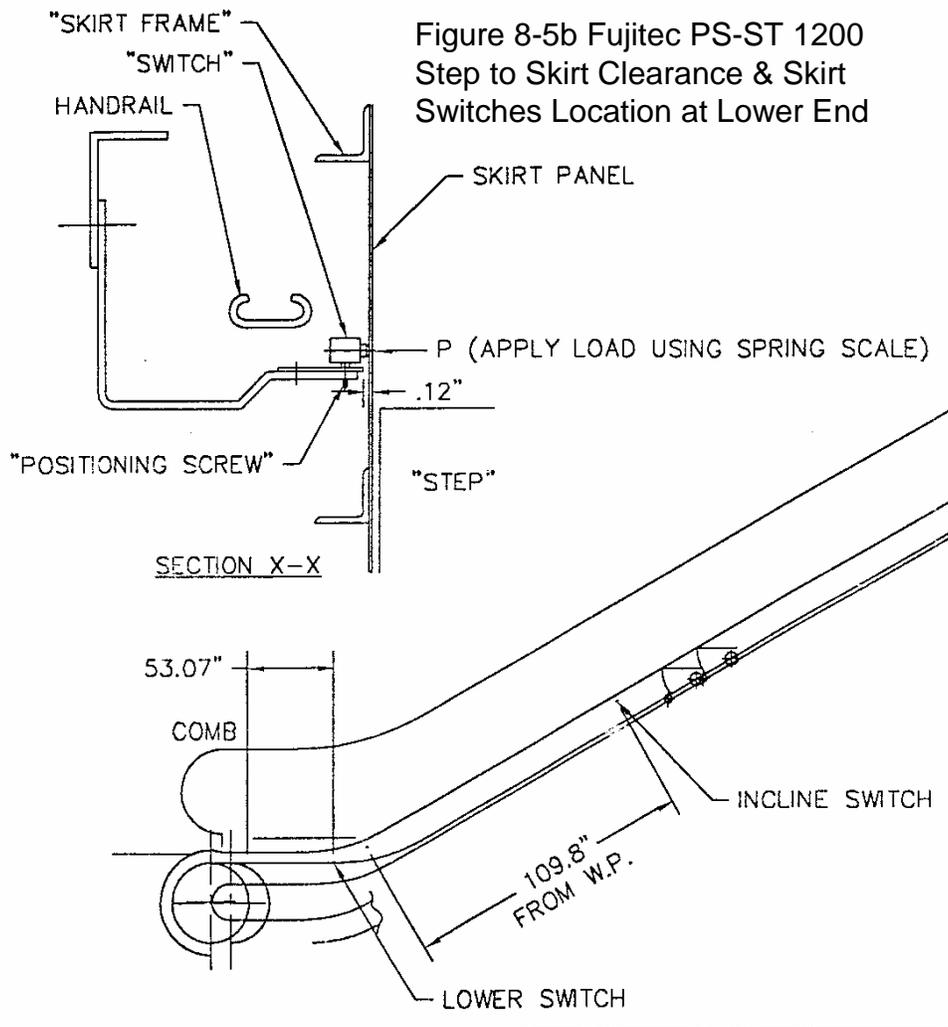
Montgomery KONE Escalator



S73G-302(10/94)

Ride the unit behind the open stepband to look for skirt panel and panel joints with exposed sharp edges, buckling or warping which may change the clearance or expose passenger to safety hazard. Repair and adjust as necessary.

Adjust the skirt if the clearance (figure 8-5a) does not remain uniform throughout the length of the travel. Remove side (interior) panel to access skirt brackets. Readjust skirt switch if necessary.



B. Inspect Skirt Safety Switches and Side Panel Gaps

Escalators installed on or after 1990 may have 2 (one on each side) or 4 skirt switches (two on each side) at both upper and lower end.

The maximum stopping distance of unloaded escalator should not exceed the distance from the location of the switch to the combplate.

Remove side panel above the skirt switch (figure 8-5c). Use a spatula to separate and to guide panels during removal and reinstallation to avoid damaging panel edges. If a panel is wedged, pull and slide the end panel towards the nearest newel end and continue pulling one panel at a time to ease dismounting. If room is not sufficient to pull panels towards the lower end, pull panels towards the upper end.

Clean, inspect for corrosion, and manipulate the **skirt obstruction device against the skirt.**

Insure that the escalator will not restart until fault is cleared and it will stop a running escalator when an object becomes caught between the step and the skirt as the step approaches the upper or lower combs.

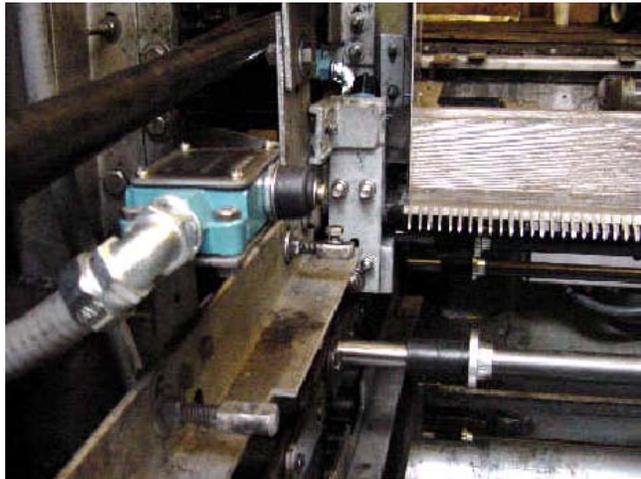


Figure 8-5c Renovated Escalator Skirt Safety Switch (skirt removed)

If after manipulation of the switch did not stop a running escalator or it can be started after actuation without controller reset, inspect the switch. There should be an audible sound from the switch upon actuation. Adjust switch if necessary.

Fujitec PS-S 1200 skirt switch plunger will be in contact with the skirt at all times.

Inspect **gaps between each side panels**; side panel bottom and skirt panel upper lips; balustrade top deck and side panel. There should be **no gap** between the side panel and the upper lip of the skirt, the side panel and the lip of the balustrade upper deck.

Gaps between each side panels shall not be wider than 5 mm (3/16 in.). The edges of side panels must be smooth to avoid injury. Adjust side panels and tighten trim if necessary. Insure that trims where installed are in place and all fasteners holding the panels are secured.

Insure that the anti-slide (puck) devices above the upper deck are all in place and secured.

Reinstall the steps, side safety brushes, and side panels.

Review Question: Write your name and answer in separate paper.

1. What is the clearance between the step tread and the adjacent skirt panel when a load of 25 lbf is laterally applied from the step to the adjacent skirt panel?
 - a) .2 inch
 - b) .5 mm
 - c) 2 inch
 - d) 50 mm

2. To safely inspect step to skirt panel clearance, you should ride a step of an open stepband, _____?
 - a) between the open stepband.
 - b) ahead of the open stepband.
 - c) behind the first step of the open stepband.
 - d) no preferable location as long as you can see the steps to skirt clearance.

3. What action should you do when testing skirt switch that failed to stop a running escalator?
 - a) Retest again.
 - b) Adjust for the correct clearance.
 - c) Stop the unit and clean contacts.
 - d) Stop the unit and inspect what caused the switch to fail.

4. What is the allowable gap between the side panels? No more than ____ inch.
 - a) 3/16
 - b) 5/16
 - c) 9/16
 - d) 3/8

5. How would you un-mount wedged side panels below the upper incline section?
 - a) Pry the side panels out.
 - b) Spray side panel edges with lubricant.

- c) Pull and slide top end side panels towards the upper newel end.
- d) Pull and slide bottom end side panels towards the bottom newel end.

FIELD PRACTICAL, SKILL TEST, Perform

Inform the Station Agent and Central Control that escalator _____ will be out of service for training.

1. Remove two side panels at the bottom landing on both LH and RH sides of a Westinghouse escalator.
2. Locate and actuate skirt switches.
3. Run the unit in normal mode of operation to actuate the skirt switches.

Actuate the LH switch. The unit should stop the running escalator.

Reset the MMI.

Perform the same to the RH switch.

If the switch failed to stop the running escalator, correct the problem.

4. Inspect side panel gaps from top to bottom and on both sides of the escalator. Make proper adjustment if necessary.

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 6: Comb Segments and Landing Plates

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Comb Segments and Landing Plates Inspection

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to;

- Clean and inspect top and bottom landing comb segments.
- Clean and inspect top and bottom landing plates.
- Identify cause of improper indexing of steps at the top landing.
- Identify cause of improper indexing of steps at the bottom landing.
- Clean and inspect comb impact safety device inspection and adjustment.
- Clean and inspect combplate safety device for Montgomery escalator.

A. Comb Segments Inspection (figure 8-6 p4)

Any comb section with one or more missing teeth should be replaced. The comb surfaces must contrast visibly by color, pattern, or texture.

ASME A17.1a-2002, 6.1.3.6.1 Combplates. The maximum allowable clearance between the bottom front of the comb fingers or teeth and top of the step thread must be no more than **5/32 inch (4mm)**.

Visually inspect each comb sections for broken or bent teeth, cracks on combs, missing screws and any object in between the combs and the step treads. **Teeth shall not have any sharp edges.** Clean the comb teeth and the area of comb segment mounting. Replace defective combs.

Verify that the comb teeth mesh with each step treadway (figure 8-6 item H p4) so that the points of the teeth are always below the upper surface of the step treads.

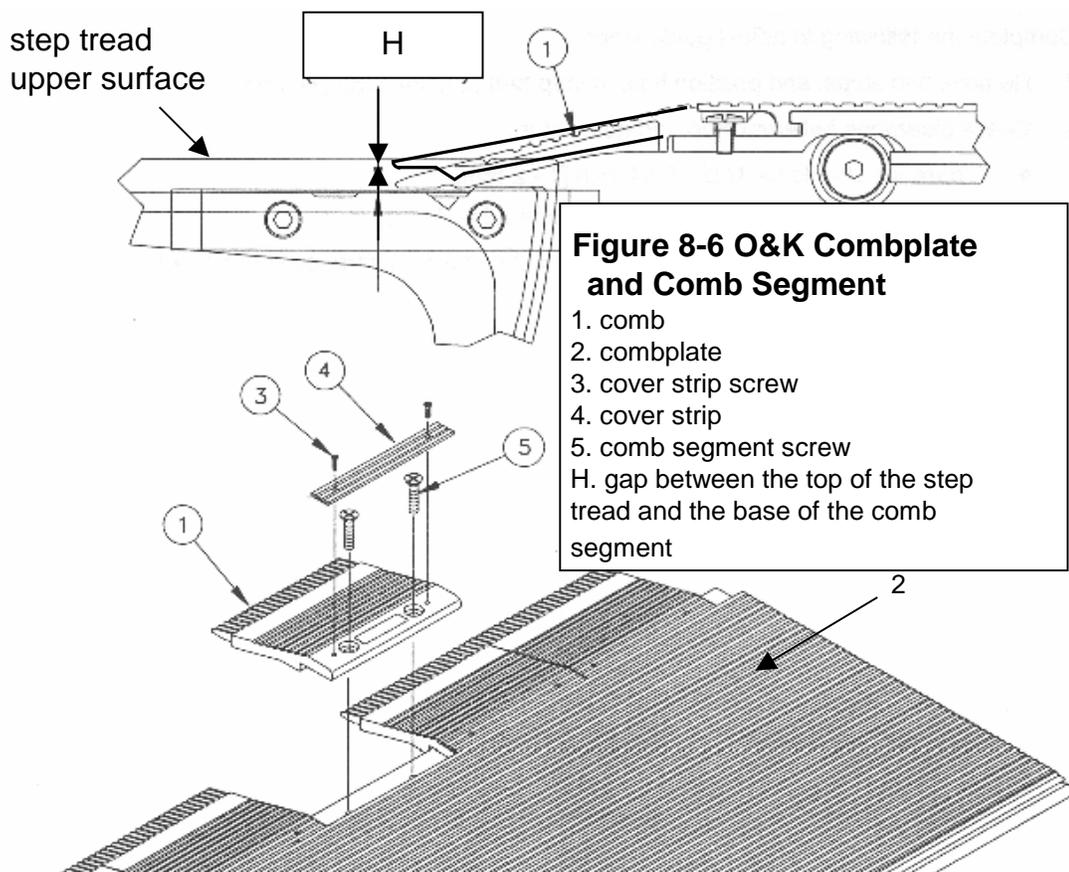
Inspect tips of comb teeth below the step tread grooves for equal clearance on both LH and RH sides of the combplate. If clearance is not equal, adjust combplate as described in Landing Plate Inspection page 7 or inspect the cause of the problem.

Run the escalator to check the steps at both landings **for proper indexing** or rubbing of steps treads against the combs teeth or against the skirt. Perform the same in the opposite travel and observe the steps indexing.

Defective step. If improper indexing is on one or two steps, mark the affected step(s). See Unit 7 Step Inspection.

If improper indexing is common to all the steps against the combs, this maybe caused by any of the most common problems as follows;

- **Step chains** wear uneven. Remove three steps to check step chains elongation and misaligned carriage. See Unit 9 Step Chain & LRS.
- **Lower carriage** misaligned. Insure that the carriage shaft is in plane. See Unit 9 Step Chain & LRS.



With the carriage spring(s) tensioned and adjusted, insure that step chains rides properly around the carriage sprockets, the chain rollers are inside the sprocket grooves.

There should be no step chain slack at the carriage outer radius and the chains should be equally tight on both sides of the carriage sprockets.

If improper steps indexing is common to both top and bottom landings, inspect;

- **Main Drive Shaft.** Move open stepband around the bull gear to inspect for step chain drive sprockets wear.

All sprockets should have similar pattern of wear inside and outside of the sprocket teeth on both LH and RH side of the bull gear.

If sprocket teeth wear is found to be uneven, further inspection is required.

Clean and inspect the main drive shaft to check for general condition.

Check the shaft with a level. The shaft must be in plane and no defective weld (figure 8-6a) or worn bearings to cause misalignment.

Report found defective weld, worn bearings or sprockets to your Foreworker for repair.

Inspect all fasteners of the pillow blocks and sprockets to be secured.

- **Combplate support misaligned.** See Landing Plates Inspection p7.

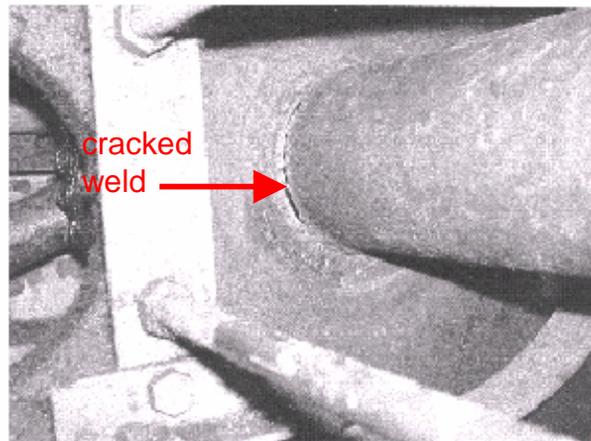
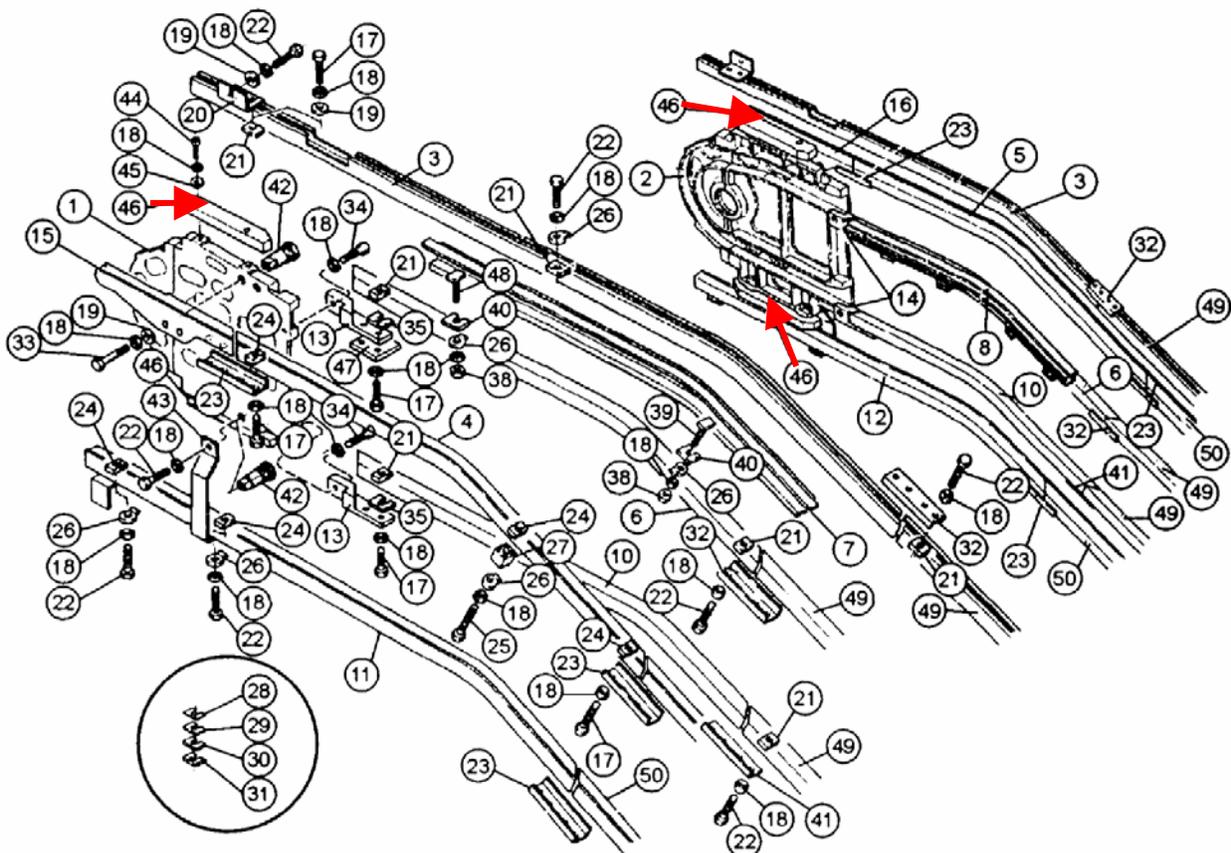


Figure 8-6a Montgomery Main Shaft w/cracked weld

- **Novatex boards** on Montgomery and Montgomery KONE escalators are not properly adjusted. See Unit 17 Novatex Chain Boards.
- **Tracks or guides** misaligned or worn. Remove five steps and move missing steps above the tracks/guides at the bottom and top landings. Check for wear or misaligned tracks. Inspect track support brackets and fastener to be secured. See items 3, 4, 5, 6, 10, 11, & 12 below.
- **Step slide strip** (item 46 below) or **guide wheels** (figure 8-6c p7) of the landing plate assembly may be misaligned or worn. Clean step slide strip and guide wheels, inspect for wear and secured fasteners. Add or remove shims to center the steps treads through the combs. Replace worn guide wheels in set.



Contract # 210 3 176 & 178-183
 Civic Center S5, S7, S9 / 16th Street S3, S2 / 24th Street S3, S2

Figure 8-6b O&K Upper Chain Guide, O&M Manual Chap. 7 page 7-84

B. Landing Plates Inspection

ASME A17.1 – 2004. The landing plate assemblies, combplate, and comb section shall not make contact with the step treads when a weight of 160 kg (350 lb) is applied to any area 200 mm x 300 mm (8 in. x 12 in.) centered on the plates with the 300 mm (12 in.) dimension parallel to the direction of travel.

Clean the landing/cover plates include the floorplates, combplates and combfingers, and guide wheels or step guides (figure 8-6c below).

Clean and inspect the cover plates tread and gaps between each plate. They should provide passenger foothold and non-slippery, no tripping hazard and/or wide gaps between each cover plate, and gaps between cover plate edges and the floor. Secure all fasteners and combfinger screws.

If improper indexing is common to all steps, access, clean and inspect landing plate assembly guide (figure 8-6c wheels on Fujitec), the combplate centering bolts of Westinghouse (figure 8-6d p8), or similar step centering assembly. Replace failed parts, guide wheels, and adjust as necessary.

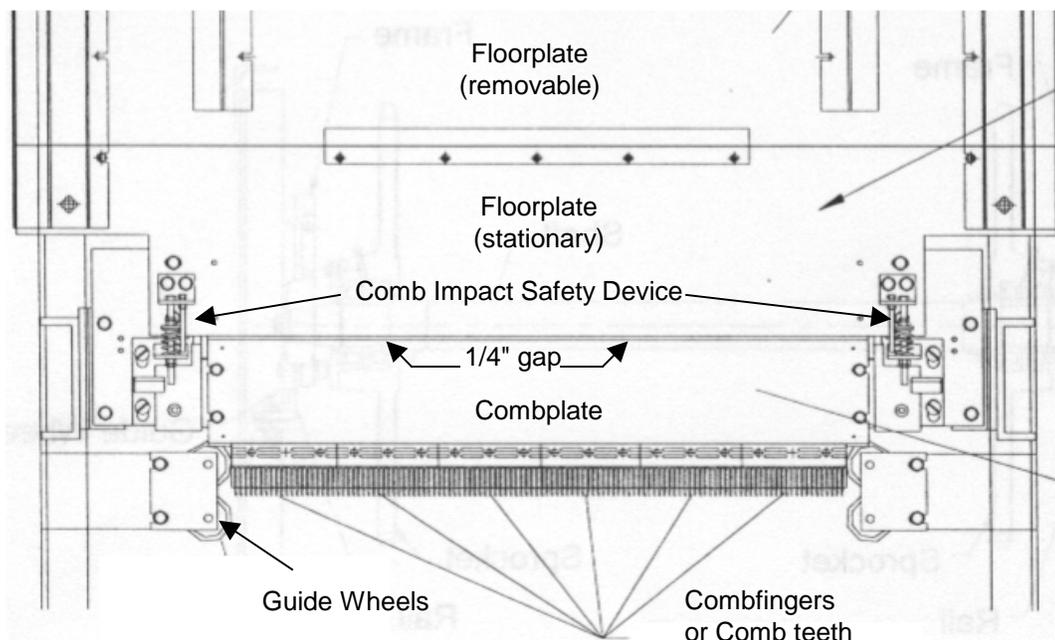


Figure 8-6c Fujitec Escalator Landing Plate Assembly

Check the rubber rollers (guide wheels) to be making contact with the step, secured and in good condition but not over tighten.

With the unit running, center your weight on the combplate LH side, the middle, and RH side respectively. The combplate shall not make any contact with the step

treads. Perform the same on all landing plates above the step at the top and bottom landings.

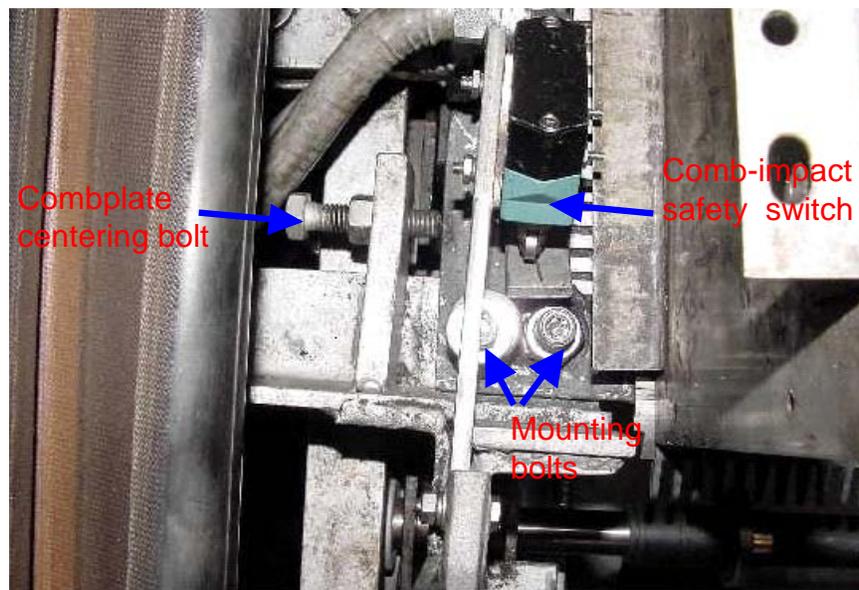


Figure 8-6d Westinghouse escalator combplate centering bolt and comb-step impact safety switch

If any of the landing plate assemblies makes contact with the step, use leveling tool to check LH and RH sides of the plate to be in plane.

Access, clean, and adjust LH and RH combplate jacking bolts (Westinghouse figure 8-6d above, or O&K side support figure 8-6e) for proper combplate elevation and the combfingers to mesh below the top of the step tread.

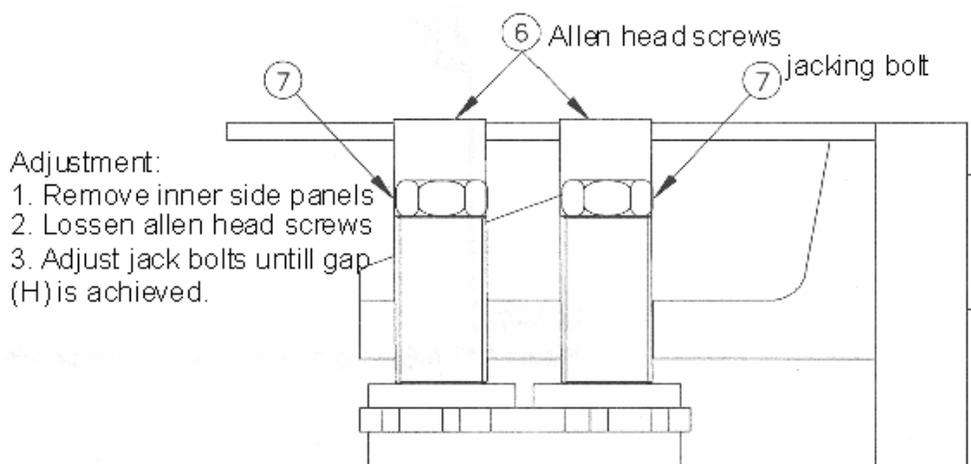


Figure 8-6e O&K Combplate Support comb segment to step clearance

C. Comb Impact Safety Device or Step Inlet Monitor

Comb impact safety device shall comply with C.C.R. Title 8 Article 26 Escalators §3126.5. This safety device shall open the power to the escalator driving machine motor and brake if a horizontal force exceeding **400 lb/ft** is applied in the direction of travel at either side, or exceeding **800 lb/ft** at the center of the front edge of the combplate, **150 lb/ft** for vertical force.

Clean the gap between the combplate and the stationary floorplate. Set the gap to **3/16 inch**.

Clean, inspect, and lubricate pivot points of the comb impact safety (figure 8-6f). Adjust comb impact safety. This job requires two-manpower and a tension gauge.

Insure that the combplate can move back to **1/8 inch** stroke to actuate the switch when an object is jamb against the combs.

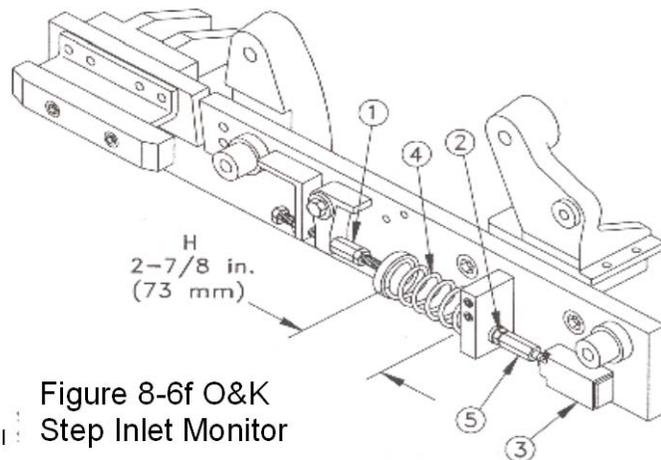


Figure 8-6f O&K Step Inlet Monitor

Insure that there is a **1/4 inch** clearance between the actuator plate of the horizontal spring and the stationary bracket for Westinghouse.

CAUTION: Turn OFF, tagout and lockout mainline disconnect.

Clean and adjust Westinghouse & Montgomery combplates parameters as required in figures 8-6g (1) & (2) p11.

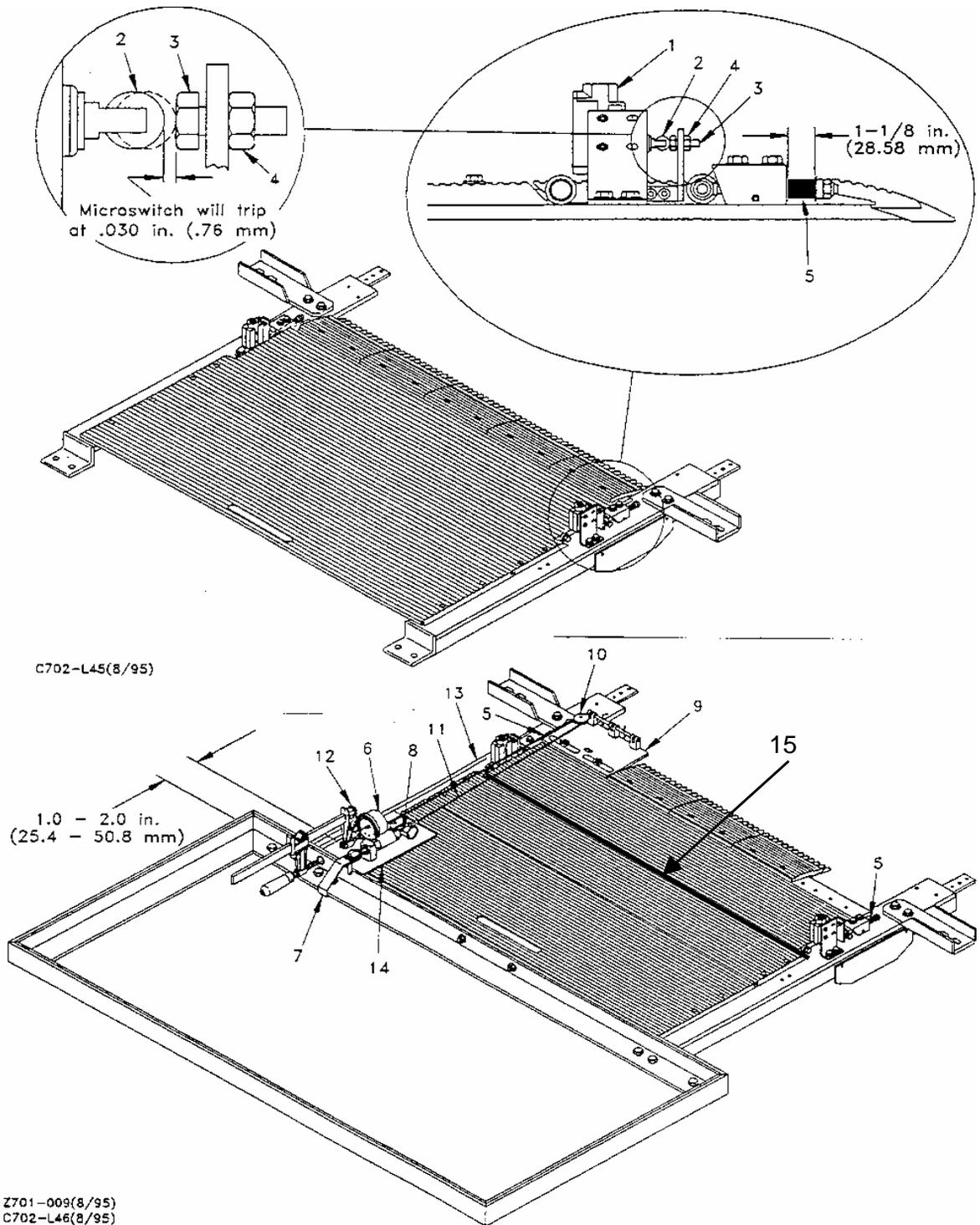
Remove comb segments at both sides and middle of the combplate.

Remove five steps and move hole in the step-belt under the combplate. Align the trailing edge of the first step with the edge of the combplate.

Move back the LH side of the combplate against the step to actuate the switch. The switch must reset when combplate is returned to original position.

Lift the LH side of the combplate to actuate the switch. The switch must reset when combplate is returned to original position.

Repeat procedure for opposite side of the escalator. Set required gaps and parameters as per manufacturer.



**To prevent scarring of combplate surface,
place a flat object (8) underneath cable end of tool.**

Depending upon your contract-specific specifications, the combplate impact devices may or may not have manual reset buttons. If you do not have manual reset buttons, the combplate impact device is reset in the controller.

Figure 8-6g Combplate Impact Safety Device, Montgomery KONE

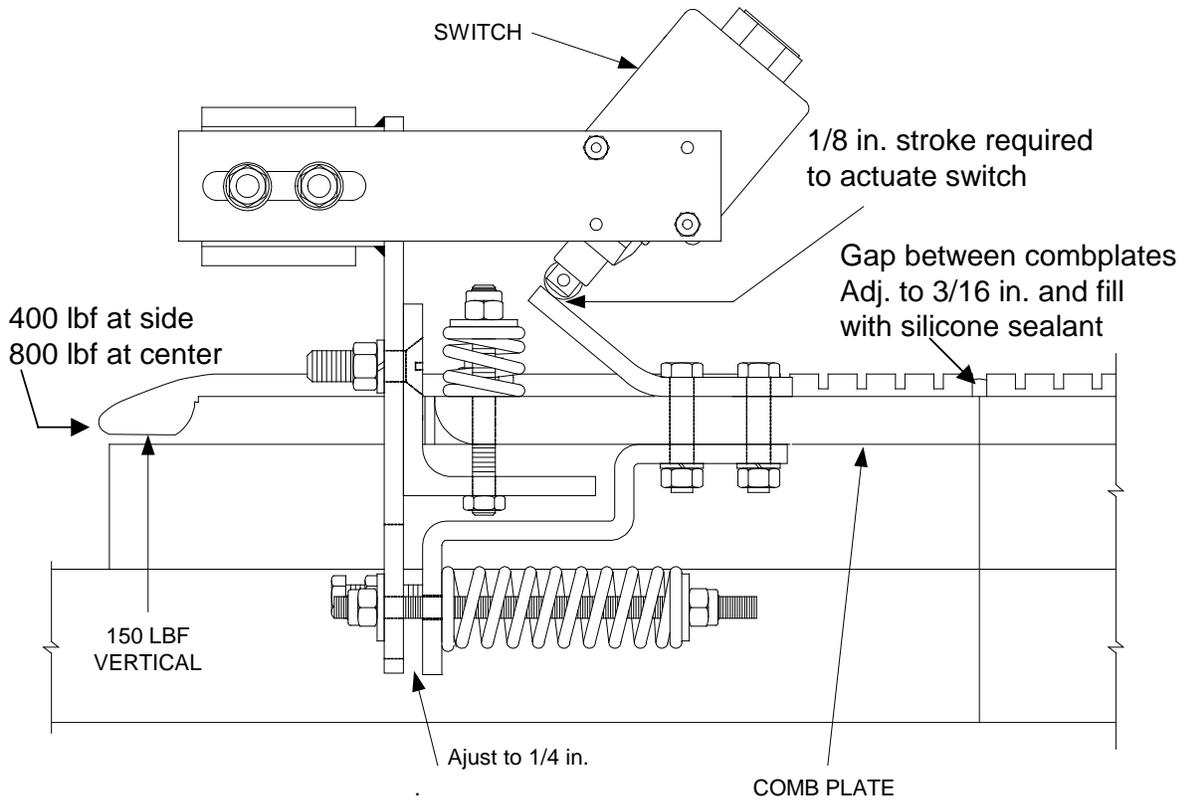


Figure 8-6g(1) Combplate Impact Device - Westinghouse

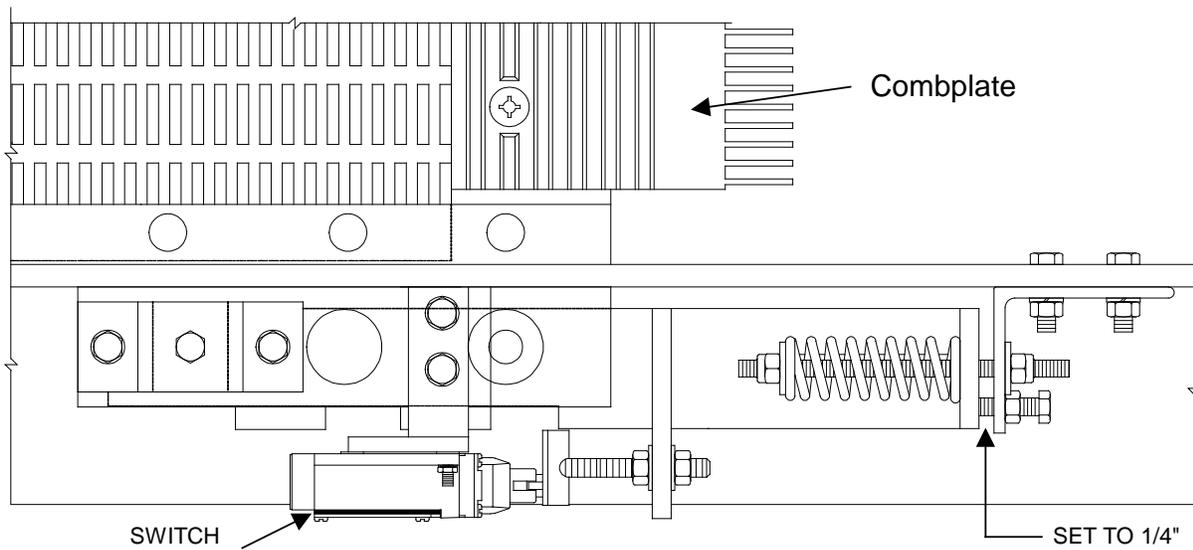


Figure 8-6g(2) Combplate Impact Device - Montgomery

Fujitec PS-S 1200 Comb Impact Device
(figure 8-6g(3)).

Remove newel skirt panels.

Clean the gap between the landing plate and the combplate. Verify the ¼ in. (6 mm or 0.24 in.) gap between combplate and landing plate is clear of debris.

Clean all debris around the springs and check all hardware to be secured.

Clean and manipulate the switches to check if they work. The fault panel LED must indicate an actuated switch.

Set all parameters of the Comb Impact Device as per Book 218 Volume 1, Section 4.

Reinstall skirt panels.

D. Combplate Safety Device Montgomery only (figure 8-6h); Inspect and Test Operate.

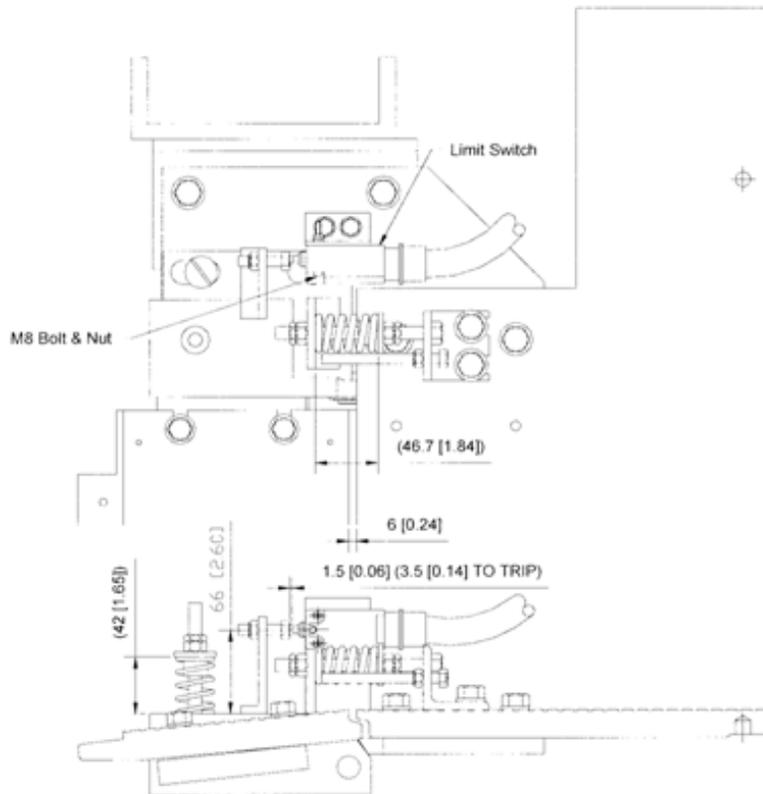


Figure 8-6g(3) Fujitec PS-S 1200 Comb Impact Device

Combplate safety devices are located at the upper trust, within 24 inches from the combs and below the trailing wheel track on both LH and RH sides. This safety device is used to stop the unit should something jam between the step and the combs or combplate.

Remove two steps and move missing stepband above the combplate safety switch at the upper end just before the combs.

Tag out and lock out the escalator before accessing the open stepband.

Clean and inspect the actuator bar and the spring washers for wear.

Clean and set the switch plunger clearance to **1/16** inch from the actuator seat by adjusting the switch assembly. Adjust the switch not too sensitive to allow the unit to shut down when the escalator is loaded with people.

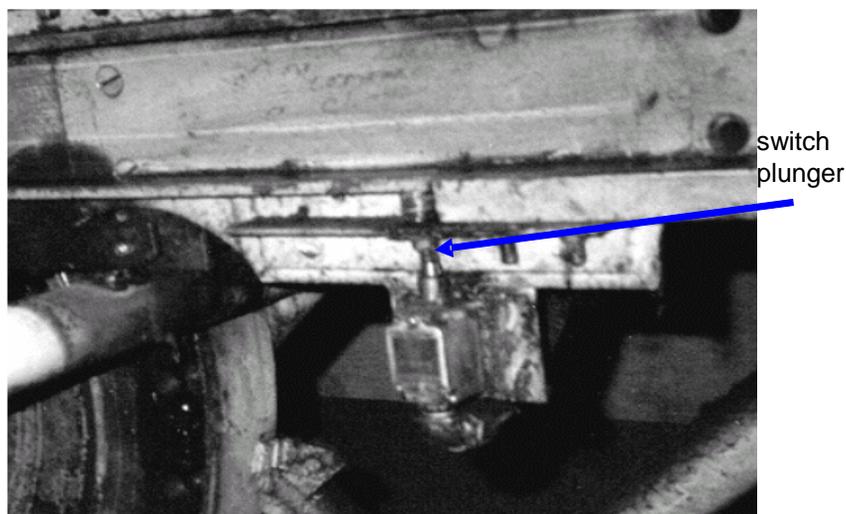


Figure 8-6h Montgomery Combplate Safety Switch (RH)

Pass a 1/16 inch gauge between the switch plunger and the actuating rod and try to manipulate, the switch should actuate. Reset the MMI.

Check all hardware to be secured.

Reinstall all the steps.

REVIEW QUESTIONS: Write your name and answer in separate piece of paper.

1. How many missing teeth per comb section is/are allowed.
 - a) One
 - b) Two
 - c) Three
 - d) Four

2. Which of the following may cause an improper steps indexing against the comb teeth at the bottom landing?
 - a) Worn step chain track.
 - b) Out of level combplate.
 - c) Worn carriage bearings.
 - d) All of the above.

3. The combplate safety device for Montgomery escalator actuates when an object jammed between ____?
 - a) the steps and the skirt at the incline.
 - b) the steps and the combs at the upper landing.
 - c) two steps just before the bottom incline of a down running escalator.
 - d) the steps and the combs at the LRS.

4. Elongated RH side step chain has no effect on step indexing since the speed of the escalator is the same on both sides of the chains.
 - a) True
 - b) False

5. ____ inch is the distance before the comb impact switch of a Fujitec escalator actuates when an object is jammed against the combs?
 - a) 3/16
 - b) 1/8
 - c) 1/4
 - d) 3/8

FIELD PRACTICAL, SKILL TEST, Perform;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

- 1. Inspect and determine upper landing steps to combs indexing.**
- 2. Clean and inspect Westinghouse Comb Impact Safety device.**
- 3. Clean and inspect Fujitec Comb Impact Safety device.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

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Unit 7: Steps Inspection

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Steps Inspection

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to;

- Clean and inspect step treads and step riser plate.
- Inspect step chain wear. Determine if “chain job” is due.
- Inspect step chain wheels and step wheels wear.
- Inspect Montgomery and Montgomery KONE escalators splice track wear.
- Determine if worn step and step parts replacement is necessary.

A. Steps, Step Treads, Step Plate, Step Axle, Step Wheels, and Step Chains Inspection

Barricade and run the escalator in its normal direction of travel.

Verify that every step treads are indexing properly in the combfingers (figure 8-7) at both landings. If improper indexing is noted, inspect the following;

- Bull gear and LRS sprockets wear, defective bearings, shaft out of plane, loose pillow block and fasteners. Replace worn parts.
- LRS guide rollers flattened or worn guide rails.
- Worn or elongated step chains. Inspect step chains at the LRS.
- Worn or loose tracks. Inspect the height of the tracks. Adjust if necessary

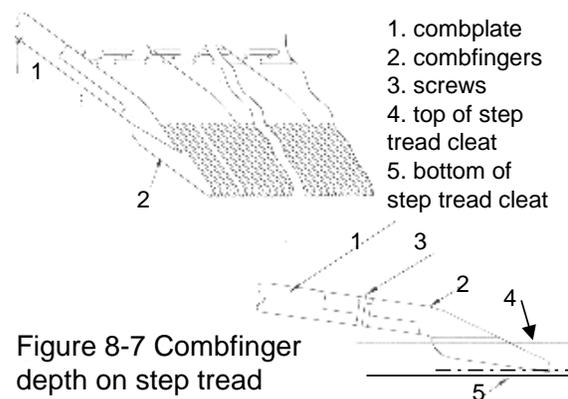


Figure 8-7 Combfinger depth on step tread

Ride and mark a beginning step. Walk each step on one side of the unit and away from the combs. Repeat the same for the other side of the steps to observe each step condition and looseness as follows;

- All steps will have some movement both vertically and laterally but must not have excessive play.
- There will be a slight sway/rock of the step front to back at the lower transition through a $\frac{1}{16}$ in. clearance between the upthrust track to step trail roller.
- An excessive front to back step rocks at the lower transition may trip the **upthrust safety device**. Adjust step wheel upthrust track to attain $\frac{1}{16}$ in. step trail roller clearance while your body weight is on the step.

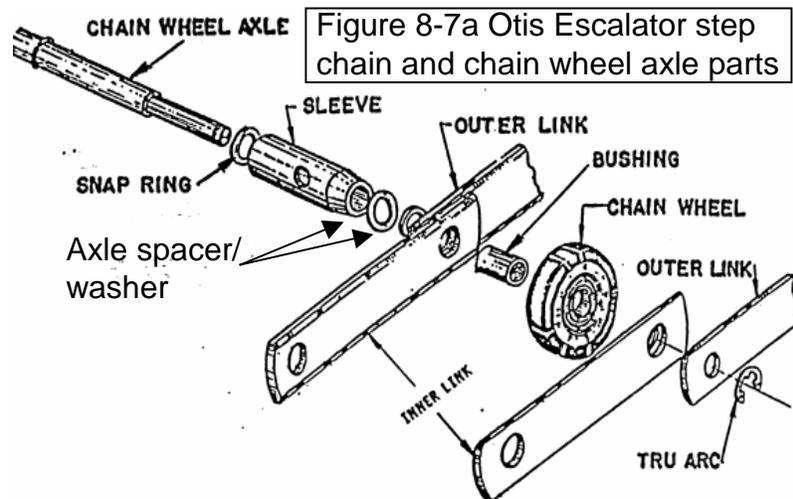
Walk the steps at the incline. Shift your weight side to side;

- There should be no excess looseness noted when weight is shifted from side-to-side in the direction of travel.
- Your weight shifted in lateral and the vertical movement should not permit the step to contact the skirt and to be displaced in a manner that prevents normal operation.
- The wheels should be **1 mm** from the vertical section of the track.

An excessive side-to-side step movement may be an indication of:

- Worn-out axle rubber bushing, step wheel, or chain wheel (figure 8-7a).
- Worn-out or missing step shim/spacer most notably on Fujitec and Otis.

Replace worn or missing step axle shims or spacers. Remove affected step. To



avoid removing the step axle off the step chains, use spliced washer, shim or rubber bushing.

If bushing is made of rubber, cut bushing diagonally with sharp knife before inserting.

Ride the unit at the incline to check steps for bumpy ride or jerking motion, if;

- All steps are bumpy at a certain area. Remove three steps and move missing step above the track where the bump occurs. Inspect and correct what causes the bump.
- The bump is on one step only. Mark the step to be check at the LRS for possible worn step trailing wheels or chain wheels.
- All steps jerk, inspect the main drive chain and the support system. Inspect main drive (bull gear) and step chain sprockets.

The main drive chain should be taut and lubricated. All main drive support system fasteners are secured.

The bull gear fasteners are secured, sprockets are not excessively worn.

Stop the escalator to visually **check step treads surfaces** as follows;

- They should provide a secure foothold.
- The treadway should provide continuous, but not ground with sharpened cleats and broken surfaces.
- Each step tread and screws should be secured. Marked each step with loose treads and screws for repair at the LRS.

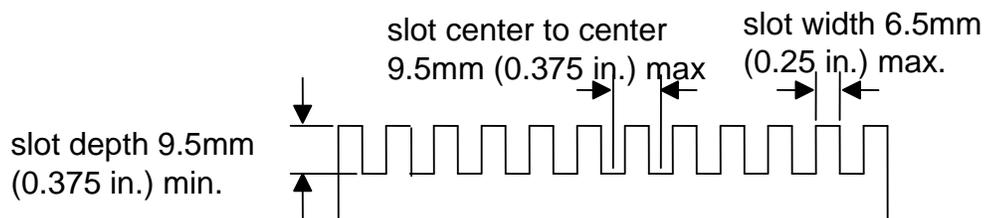


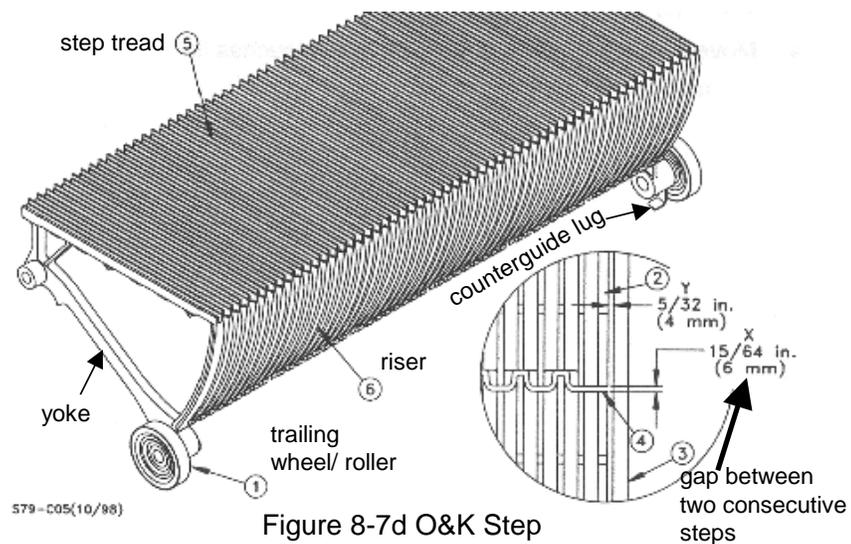
Figure 8-7b Step Treads and Slots

CCR Title 8 Article 13 (ASME A17.1a -2002). Each slot shall be not more than $\frac{1}{4}$ inch wide and not less than $\frac{3}{8}$ inch deep and the distance from the center to center of adjoining slots shall be not more than $\frac{3}{8}$ inch.

Slots shall be so located on the step tread surface as to form a cleat on each side of the step tread adjacent to the skirt panel (figure 8-7d item 3).

Verify at the incline that both LH and RH cleats of the escalator step tread mesh with the vertical cleats in the step riser (figure 8-7d item 4).

- If the vertical cleats do not mesh with the slots of the adjacent step riser, and the gap between two consecutive steps is more than $\frac{15}{64}$ inch, the step chain is worn. Inform your Foreworker that chain job is due.
- If one side is wider than the other side, the step chains are unevenly worn. Inform your Foreworker that chain job is due.
- Use a level to determine that the steps at the top and bottom landings are horizontal or in plane. An out of plane step may be caused by worn;
 - a) step trailing wheel,
 - b) trailing wheel axle,
 - c) an "A" frame (yoke),
 - d) chain wheel,



- If all steps are out of plane, inspect the following for defects/wear;
 - a) step and chain tracks,
 - b) bull gear and lower carriage.

Visually inspect each step side plates inside the LRS. If found to be badly worn or damage, replace the step.

Check the **side plate** of older Montgomery escalator steps for **crack**.

It is **important to know that crack(s) on the side plates** (figure 8-7e) is an indication of the novatex board improperly adjusted or metal fatigue. Repair or replace step as necessary;

- Steps with **type “A” cracks** do not necessarily require replacement. A **¼ in. hole may be drilled at the end** of the crack to provide smooth surfaces at its end. But, if the crack has progressed over the bend in the step body wrapper sheet and turned toward the side of the step, the step must be replaced.
- Steps with **type “B” cracks** require step replacement.
- **Replace the step if the crack on the step body wrapper sheet is zigzag.**

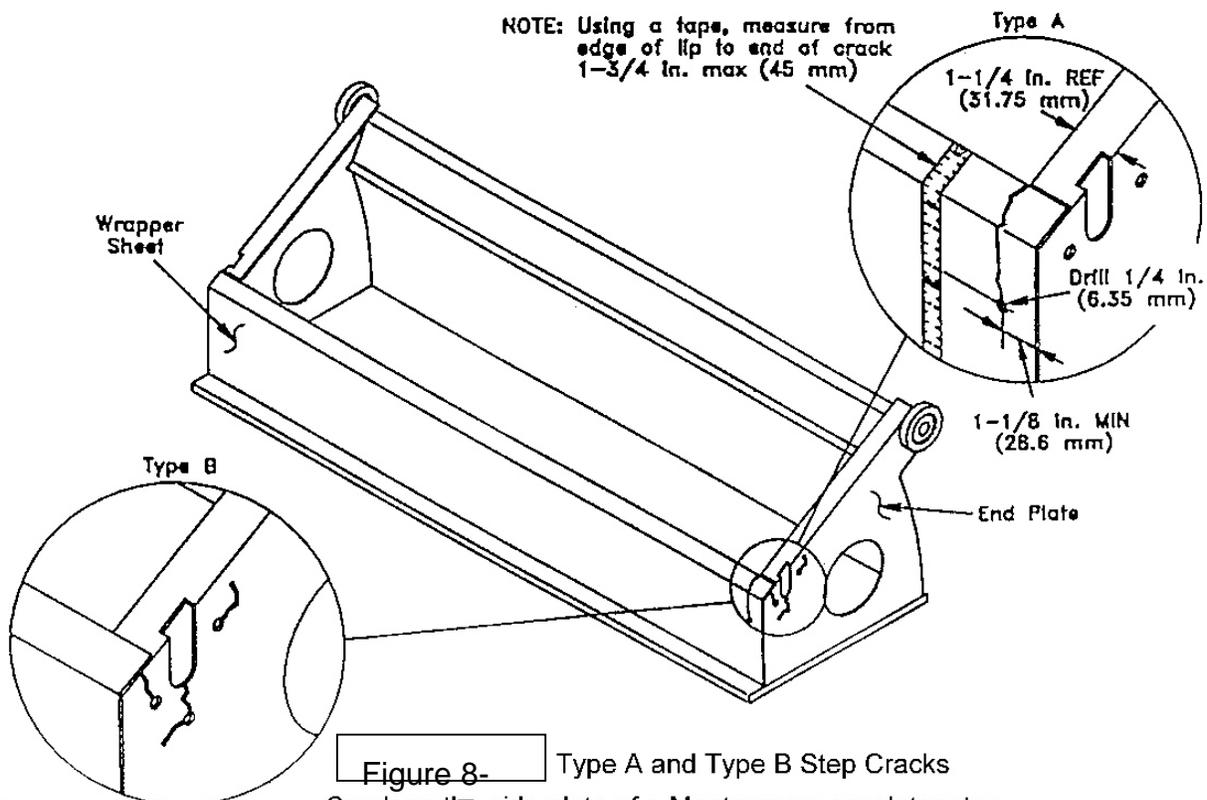


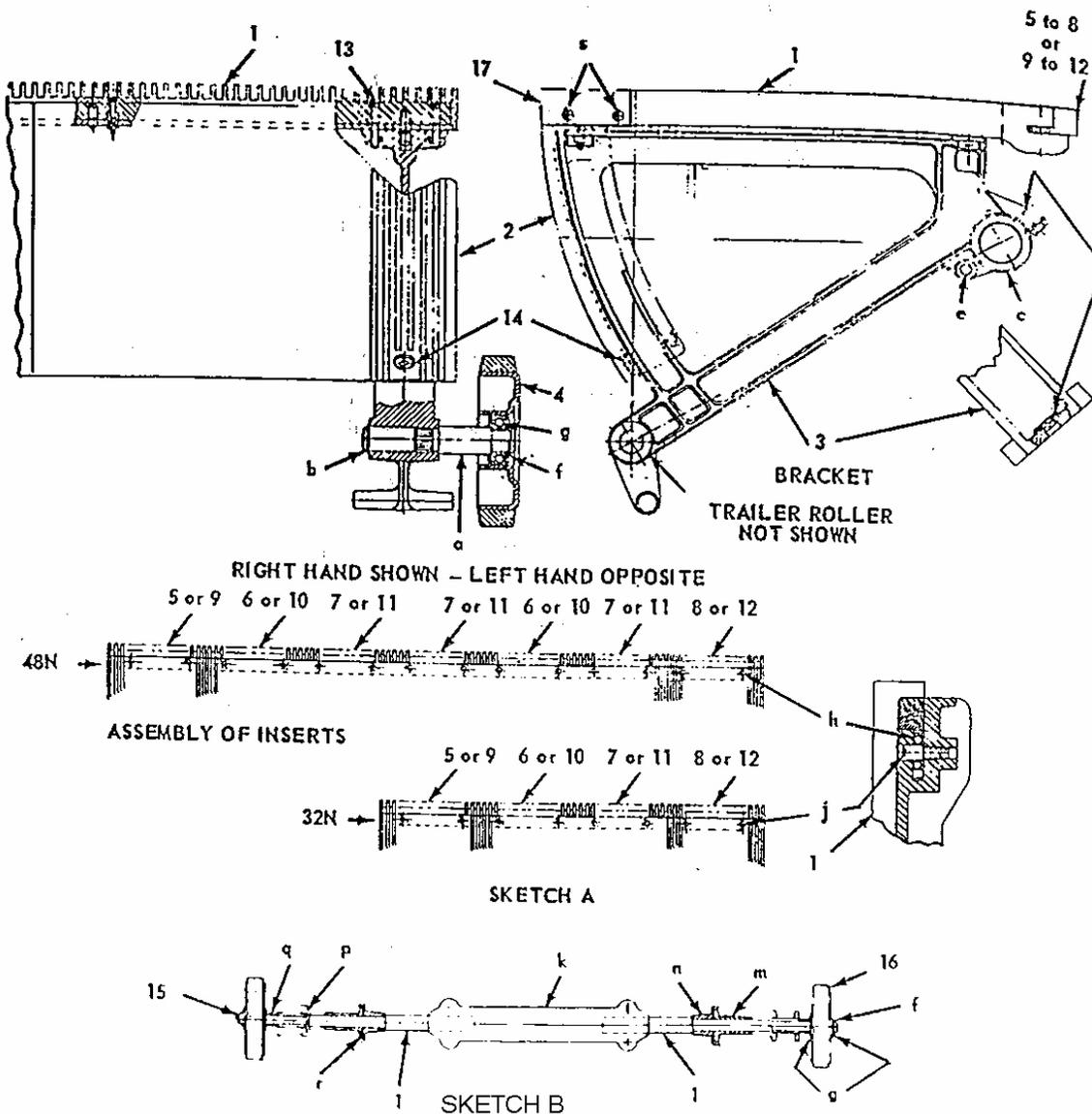
Figure 8- Type A and Type B Step Cracks
Crack on the side plate of a Montgomery escalator step

Inspect Westinghouse **endplate** and **demarcation strips** (figure 8-7f).

- Inspect demarcation strips. Look for broken, missing, pointed tips, or loose fasteners. Replace worn demarcation strip and check all fasteners to be secured.
- Look for missing or worn endplate (item 17). A missing endplate may actuate mechanical Missing Step Device. Replace missing endplate.

Figure 8-7f

Westinghouse Escalator Step Assembly, Type N, See next page for parts list.



Westinghouse Escalator Step Part's List

SKETCH DESCRIPTION	ION	u8N
A	assy. with Grooved Riser-Yellow Inserts	53UF, .039 Δ
1.	Step Tread Assy-Yellow Demarcation Inserts	Sim. 627D258-G19 Δ
2.	Riser Assembly Grooved - Black	Sim. 323C501-G04 *
3.	Bracket Assembly	321C809-G05
	a. Shaft	322C606-G02
	b. Truarc Ring	Sim. 569A799-H01 Δ
	c. Cap	Sim. X678 77
	d. Plug Nut	∅
	e. Truarc Ring	Sim. 144A544-H05 77
4.	Trailer Roller & Bearing Assy	Sim. X6BD1 77
	f. Truarc Ring	216B509-G04
	g. Washer	Sim. to X67133 77
9.	Demarcation Inserts - Yellow	Sim. to X6D11 77
10.	Demarcation Inserts - Yellow	321C596-H12
11.	Demarcation Inserts - Yellow	321C596-H13
12.	Demarcation Inserts - Yellow	321C596-H14
	h. Rubber "O" Ring	321C596-H11
	j. Screw	144A541-H01
13.	Screw	Sim. 144A542-H03 77
14.	Plug Nut	Sim. X5BQ-1 77
17.	End Plate - Left Hand	Sim. X4M3 77
	- Right Hand	215B768-H01
	s. Screw	215B768-H02
		Sim. X5729 77
B	m. Axle Bushing	K5863-1
	n. Axle Collar	K5597-2
15.	Shaft Assembly	216B673-G04
	k. Half Coupling	322C647-H02
	l. Shaft	325C781-H04
16.	Roller & Bearing Assembly	217B235-H07
	f. Truarc Ring	Sim. to X67-133 77
	g. Washer	Sim. to X6F11 77
		K5863-1
		K5597-2
		216B673-G05
		322C647-H02
		325C781-H05
		217B235-H07
		Sim. to X67133 77
		Sim. to X6F11 77

NOTE - A complete step consists of one step assembly & one back axle assy.
 Δ Sim. to except Ferrous Hdwre. including Truarc Rings Cadmium Plated & It. 19 on 323C501
 * Paint Finish per 630B182 & coat exposed shaft. It. 9 per 335B Slush Compound.
 Sim. to except Ferrous Hdwre. including Truarc Rings Cadmium Plated & It. 19 on 323C501
 Δ Paint Finish per 630B182
 Sim. to except apply 375B Slush Compound.
 77 Sim. to except to be Cadmium Plated.
 ∅ When a new Cap Item (c) is required, a whole new brkt. must be ordered.

Check the steps that are affected by worn or elongated step chains which may be indicated by;

- **Poor step indexing** normally observed at the LRS flat steps and before the combs.
- **Gaps of more than 15/64 in. between two consecutive steps** treads or demarcation at the flat just before the combs (figure 8-7d p6).
- **Cave-in wear of step risers** on all the steps near the side plates is an indication of adjacent step clamps (knuckles) rubbing against the adjacent riser at the LRS found on Westinghouse escalator.
- A **knocking sound at the LRS** on Montgomery and O&K escalators. The step trail rollers dipping down at the make-up tracks gap due to worn-out step chains or make-up tracks (figure 8-7g below).

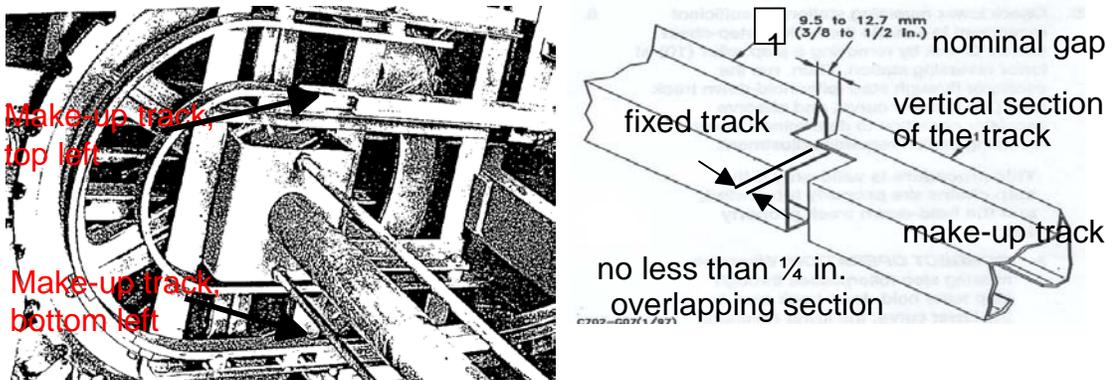


Figure 8-7a Montomerv & Montomerv KONE Make-Up

If make-up tracks are worn, remove five steps. Replace and adjust tracks.

If step chains are worn that the carriage spring adjustment is max out, report to your Foreworker for chain replacement (“chain job”).

Inspect **step wheels and chain wheels at the LRS:**

- Run the unit with a remote control to inspect step and chain wheels for wear and tear.
- Insure that the wheels ride around the circle tracts, exits and enters the guide tracks smoothly without bumping and not wobbly.

- If a defective wheel is found, **replace them in pairs**. Step wheels should be installed so that the guiding surface (wider metal surface) of the wheel is toward the vertical section of the track.

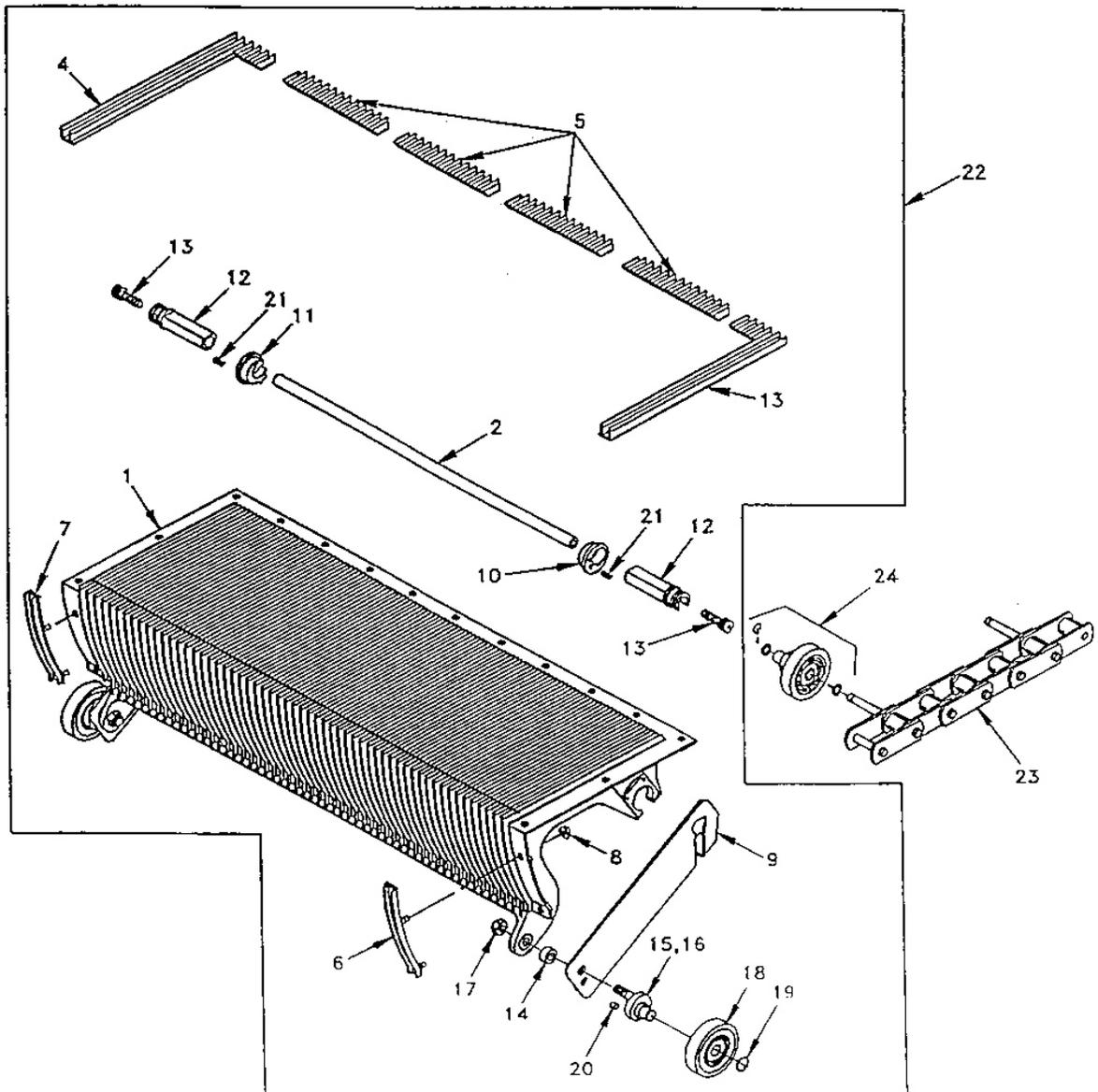
Inspect **step demarcation strip** for Montgomery (figure 8-7h item 5 below).

Inspect all step hardware and fasteners to be secured and not worn.

Replace defective parts.

Steps Figure 8-7h Montgomery KONE Step Assembly
See next page for parts list.

STEPS & STEP CHAINS



KEY	MECOPART	SPAREPART	PARTNAME	QTY	REMARK
1	93017-001	SP	Step, cast	1	5E, aluminum
2	67821-001		Shaft, step, through axle	1	5E
3	69464-004	SP	Insert, tread	1	RH, silver flake
4	69463-004	SP	Insert, tread	1	LH, silver flake
5	69465-004	SP	Insert, tread	4	Middle, silver flake
6	69462-004	SP	Insert, riser	1	RH, silver flake
7	69461-004	SP	Insert, riser	1	LH, silver flake
8	69727-001		Nut, metal insert	19	
9	93028-001		Plate, step adapter	1	RH
9	93028-002		Plate, step adapter	1	LH
10	69817-001		Plug	1	RH, step adapter, with lug
11	69817-002		Plug	1	LH, step adapter, with lug
12	67436-001		Sleeve, step, axle end	2	
13	39613-003		Screw, HSC/SK	2	3/8-16 x 1, UNC, nylock
14	69818-001		Spacer, step adapter	2	
15	93029-001		Axle, stub	1	RH, step adapter
16	93029-002		Axle, stub	1	LH, step adapter
17	47401-006		Nut, hex	2	3/4-18
18	P-12963	SP	Wheel assembly	2	3-15/16 inches diameter, with bearing and snap ring
19	16085-011		Snap ring, external	2	7.33 D x .046 W
20	68431-001		Pin, dowel	2	3/8 D, L= 50 in.
21	68459-001		Spring, step	4	.25 D, L = .75 in.
22	P-32405-001	SP	Step, cast, assembly	1	With 100mm wheel, black painted nose, silver trim
	P-32405-002		Step, cast, assembly	1	With 100mm wheel, yellow painted nose, silver trim
	P-32405-003		Step, cast, assembly	1	With 100mm wheel, red painted nose, red trim
	P-32405-004		Step, cast, assembly	1	With 100mm wheel, black painted nose, black trim
23	92164-001	NSP	Chain, step, roller	6	4 pitch
23	92165-001	NSP	Chain, step, roller	28	24 pitch
24	P-27879	SP	Roller, with spindle		4 D, 7/8 W

Montgomery KONE Escalator Step and Step Chain Parts List

REVIEW QUESTIONS: Write your name and answer in separate piece of paper.

2. A Westinghouse escalator missing step sideplate may actuate which of the following safety device?
 - a) Upthrust
 - b) Comb impact
 - c) Step out of alignment
 - d) Missing step, mechanical sensor
3. What is the maximum allowable gap between leading step riser and a trailing step tread?
 - a) 1/16 in.
 - b) 1/8 in.
 - c) 15/64 in.
 - d) 1/2 in.
3. Which of the following statement tells you that the step chains are worn or elongated?
 - a) Tripping of the main drive chain switch.
 - b) Sound of dropping step wheels at the LRS on Montgomery.
 - c) More than 1/4 in. gap between two consecutive steps treads at the flat.
 - d) All of the above
4. You should ride the steps away from the combs during step inspection of a running unit.
 - a) True
 - b) False
5. When replacing a defective step wheel, replace only the defective one.
 - a) True
 - b) False
6. A defective step wheel would most likely trip which of the following safety device?
 - c) Step upthrust
 - d) Missing step switch
 - e) Step chain switch
 - f) Step out of plane

FIELD PRACTICAL, SKILL TEST, Perform;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

- 1. Demonstrate how inspect step treads and step riser.**
- 2. Demonstrate how to inspect out-of-plane steps both at the upper and lower landings.**
- 3. Determine if a Westinghouse escalator step chains is due for replacement.**
- 4. Determine if a Montgomery escalator step chains is due for replacement.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 8: Gear Bucket and Gear Case

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Gear Bucket and Gear Case

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to;

- Clean, inspect and lubricate external gears.
- Identify worn sprockets and gears.

A. External Gears and Sprockets, Gear Bucket of Montgomery & Montgomery KONE; Inspect and Lubricate

Remove five but no more than six consecutive steps to access the upper truss.

- Clean and inspect the area around the bucket for oil leak and metal chips. Metal chips fillings is most likely an indication of grinding gears improperly lubricated.
- Check the gear bucket for proper oil level. Perform procedures as described in figure 8-8a p4. Inspect dip pointer adjustment, any leak or an overflow of oil bucket and oil spillage.
- Clean and inspect the pinion and ring gears to be meshing properly and not worn (figure 8-8). The top land surfaces of the gear teeth or the tooth faces should be flat and not worn.



Figure 8-8 Montgomery Escalator Worn Pinion & Ring Gears Inside an Oil Bucket

Figure 8-8 above is a Montgomery escalator whose pinion and ring gears are totally worn from lack of lubrication. The oil bucket below the pinion gear is totally dried and crushed.

Replace the oil in the gear bucket if dirty and contaminated or at every 3600 hours (semi-annually) of operation.

OIL BUCKET - INDOOR ESCALATORS

MONTGOMERY ESCALATOR OIL BUCKET (MONTHLY PM)

Perform the following adjusting procedures for the oil bucket.

1. Examine oil bucket for proper oil level (1). Add oil to correct level.

Correct oil level is 1 inch from top of dry well (2).

2. Examine oil bucket for correct operation. The dip pointer (3) should just transfer one drop of oil to ring gear (4) without bottoming out in ring gear tooth.

If dip pointer rubs the ring gear or a small noise is heard caused by dip pointer hitting both sides of ring gear, adjust oil bucket to apply only one drop of oil to ring gear tooth by one of the following methods.

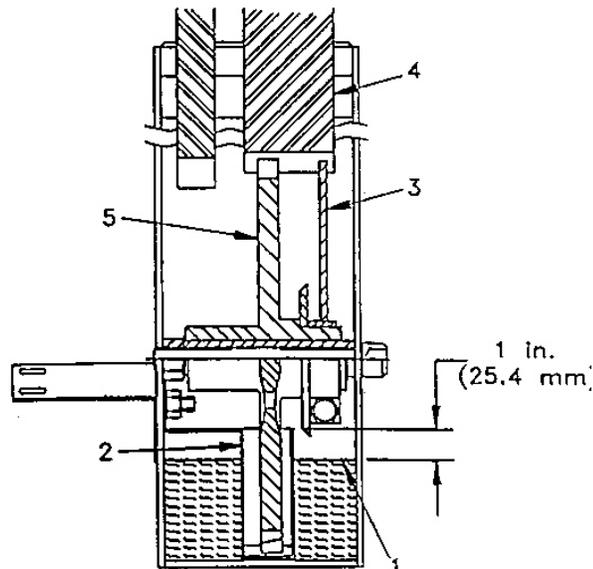
- Dress tip of dip pointer with a file to lessen the depth of dip pointer penetration into ring gear tooth. Depth of dip pointer penetration changes the amount of oil transferred to ring gear.
- Bend dip pointer in or out, or rotate dip pointer forward or back on the hub for proper alignment with ring gear tooth.
- Move entire oil bucket assembly uphill or downhill to adjust alignment of dip pointer to ring gear tooth.

To move the oil bucket assembly uphill or downhill, adjust in the following manner.

1. Loosen carriage bolts mounting oil bucket to track.
2. Slide oil bucket uphill or downhill until there is 1/32 inch backlash between timing gear and ring gear.
3. Tighten carriage bolts mounting oil bucket to track.

After tightening bolts, make certain clearance between timing gear assembly (5) and ring gear (4) has not changed.

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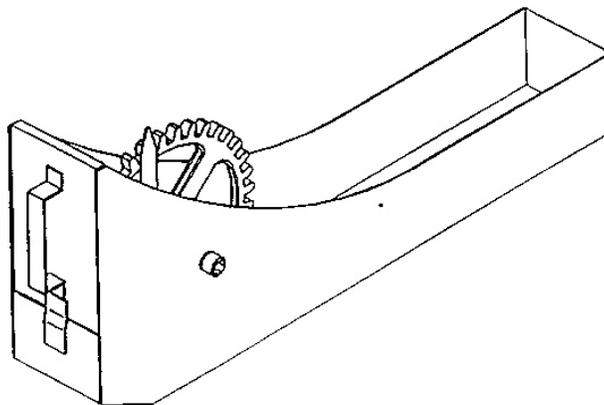
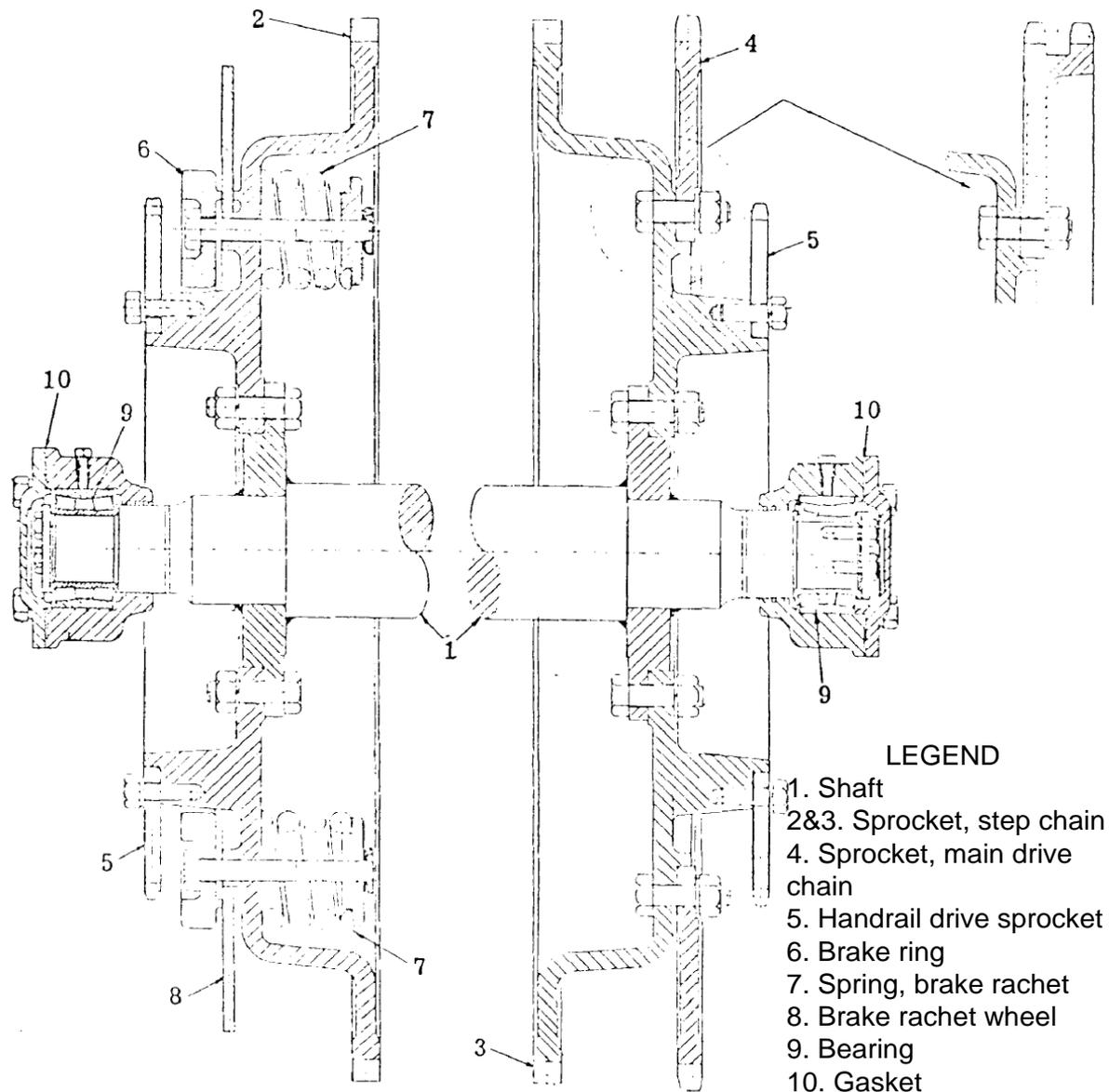


Figure 8-8a

TOP SPROCKET ASSEMBLY

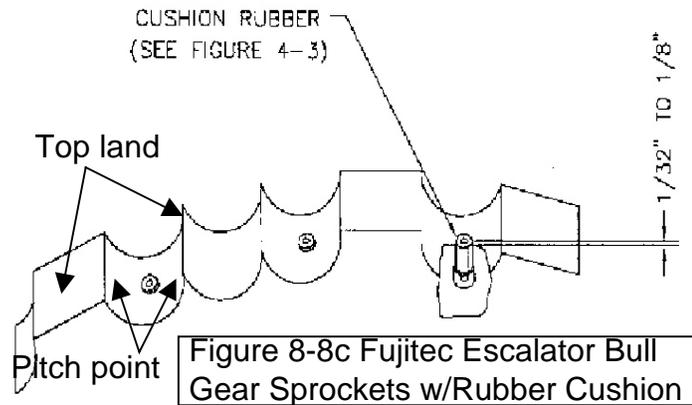
Figure 8-8b Westinghouse



Inspect the LH and RH handrail drive sprockets (item 5 above) to be meshing against the handrail drive chain and they are not worn and dry. The sprocket teeth should have a smear of oil. Inspect the meshing of the sprockets against the step chains (item 2 above) to be square. Inspect the sprockets against the main drive chain (item 4 above). All sprockets should be worn evenly.

Inspect the brake ratchet wheel (item 8) fasteners and springs to be secured.

Insure that the top land surfaces and pitch points (figure 8-8c) of the sprockets should not show pattern of abnormal wear. **Excessive cave-in pinch points on one side or maybe on both sides is an indication of worn chains.**



Inspect cushion rubbers (figure 8-8c) where applicable for wear and tear. Replace worn rubber.

B. Gear Case/Box; Clean and Inspect

Clean the surroundings of the gear case to avoid oil contamination and to prevent dirt built-up around the breather (figure 8-8d p8).

Check for any oil leak from the gear case. If an oil leaks occurs, inspect worn gasket or seals for wear.

Repair any excessive oil leaks immediately.

Run the escalator to normal operating temperature in both direction and observe for any abnormal noise from the gears, vibration, and oil leak. Check for an excessive backlash of the worm gear shaft that maybe caused by:

thrust play of the thrust bearings.

wear of the worm gear.

wear of the pinion gear inside the gearbox.

If abnormal noise and vibration from the gears occurs, inspect for;

- proper lubrication,
- loose hardware and/or fasteners,
- misaligned motor and gearbox,
- damaged key and/or key way,
- and worn or damaged spindle.

Stop the unit to check the bearing housings of the; motor, gear case, and the support blocks with bare hand for any excessive heat.

If unable to hold your bare hand on top of any bearing housing because of heat, the bearing may be subjected to wear or lack of lubrication.

Check all axles and bearing housing for metal chips and rust. Use a level to inspect all gear axles to be in plane and aligned.

Check the gear case oil level. Add fresh oil to proper level if required. Do not overfill the gear case.

Clean and remove inspection plate to inspect the inside of the gear housing. Inspect oil for contamination. If an indication of discoloration or contamination is present, replace and flush the gear oil as follows;

- Remove drain plug and drain oil into a container. Dispose old or contaminated oil into proper disposal area.
- Remove sludge, clean and flush gear housing with cleaning fluid. Wipe any cleaning fluid residue inside the gear housing.
- Clean and examine the oil breather. Blowout holes to remove any leftover cleaning fluid. Replace drain plug.
- Fill the gearbox with proper gear oil until oil level covers approximately **2/3 of worm gear or at site level indicator.**

Use Mobil GLYGOYLE 30 Synthetic Oil or equivalent lubricant.

- After refilling, check oil level with dipstick or other installed measuring device. If oil level is high, remove excess.

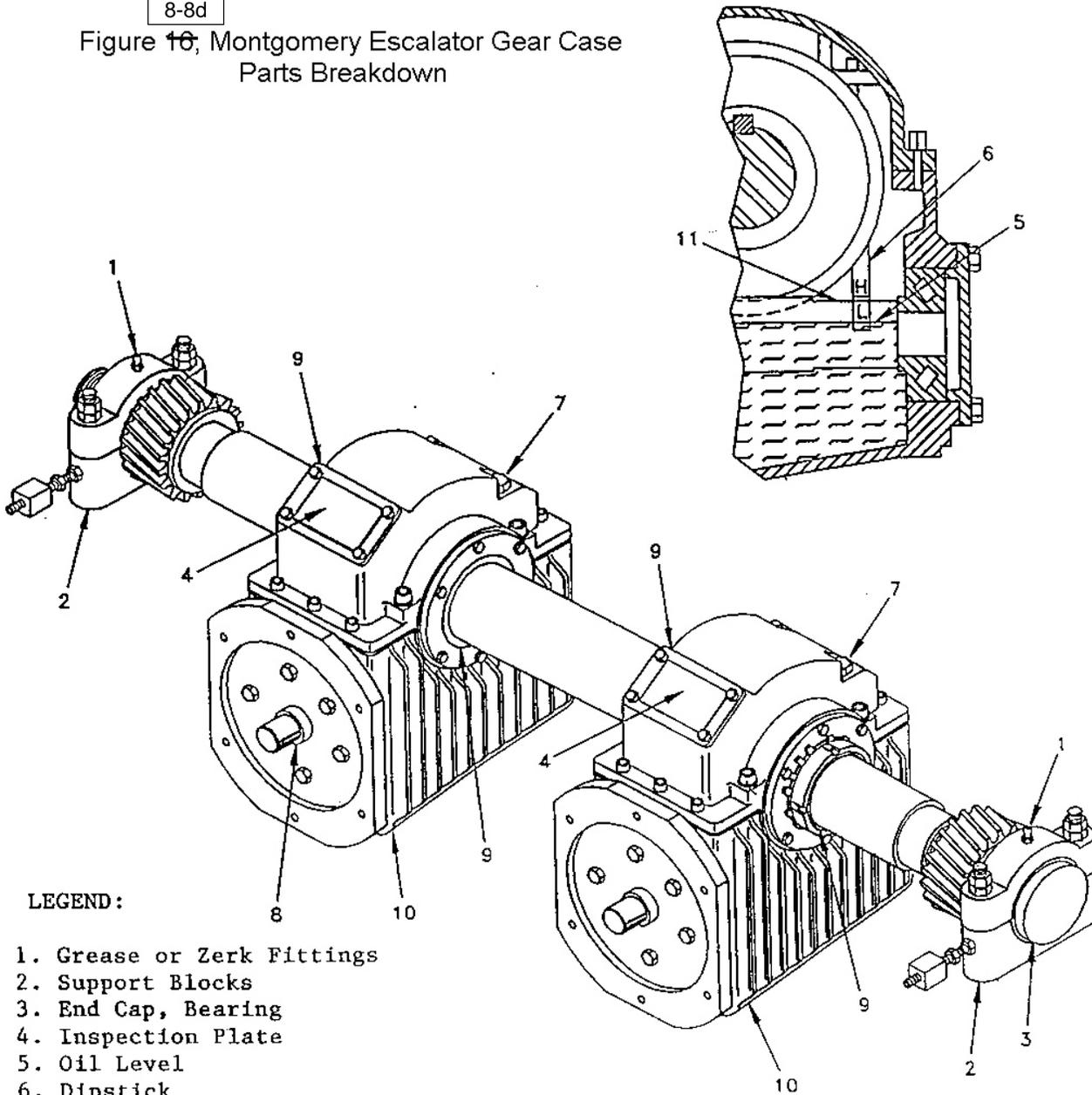
Westinghouse machine with **angle bedplate**, the oil level should be **1 inch below the sprocket shaft of the pinion gear.**

It is important that the oil level is kept at the correct level. Excess oil will cause heat built-up from excessive oil agitation. Static pressure from excessive oil level may cause seals to leak.

Replace inspection plate. Insure that the gasket is properly installed.

8-8d

Figure 16, Montgomery Escalator Gear Case
Parts Breakdown



LEGEND:

- 1. Grease or Zerk Fittings
- 2. Support Blocks
- 3. End Cap, Bearing
- 4. Inspection Plate
- 5. Oil Level
- 6. Dipstick
- 7. Oil Breather
- 8. Speed Seals
- 9. Speed Seals
- 10. Drain Plug
- 11. Worm Gear

REVIEW QUESTIONS: Write your name and answer in separate piece of paper.

1. How much oil should you have inside a Westinghouse machine with angle bedplate? The oil level should be _____.
 - a. 2/3 of the worn gear.
 - b. 1/3 of the worm gear.
 - c. 1 inch below the sprocket shaft of the pinion gear.
 - d. 1 inch above the sprocket shaft of the pinion gear.

2. How often should you replace the gear bucket oil? Every ____ ?
 - a. ½ year
 - b. year
 - c. 2 years
 - d. PM visit

3. Explain what would be the effect of worn pinion gear inside the gearbox.

4. How does the ring gear in figure 8-8a page 4 get lubricated?

5. Worn sprocket teeth will show all of the following, except?
 - a. Uneven top landing surfaces.
 - b. Shiny pinch points.
 - c. Metal chips below the sprockets.
 - d. Cave in pinch points

FIELD PRACTICAL, SKILL TEST, Perform;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Demonstrate how to:

- 1. Remove 5 steps to access and to inspect the condition of Montgomery escalator gears and oil level inside the gearbox.**
- 2. Access and inspect the condition of Westinghouse escalator pinion gear and oil level inside the gearbox.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 9: Step Chain and Lower Reversing Station (LRS)

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Wear suitable work glove, use a broom, a wide blade spatula or a dustpan to pick up debris.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Step Chain and Inspect Lower Reversing Station (LRS)

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to;

- Lubricate and inspect step chains.
- Clean, inspect and lubricate Lower Carriage Assembly.
- Inspect and make proper step chain tension adjustment.
- Determine when step chains are due for replacement.

A. Inspect and Lubricate Step Chain

Access the LRS and place the inspection switch to "INSPECT".

Clean debris and foreign materials in the pit and the water separator, if equipped. Empty any collected oil from the collector to a proper container and refill separator with water as necessary.

Place the unit in Normal/Run. Run it in the up travel with the Remote Control.

Inspect Step Chains

Listen to abnormal noise such as grinding, squealing, and clucking.

Insure that the step chains are not riding high on the sprockets and the chain rollers are inside the grooves.

Look for chain appearance, stiff bending, kinks, corrosion, damage to outside surface of roller, and chain does not seem to straighten out. If reddish brown color is noticed, lubrication is improper or insufficient.

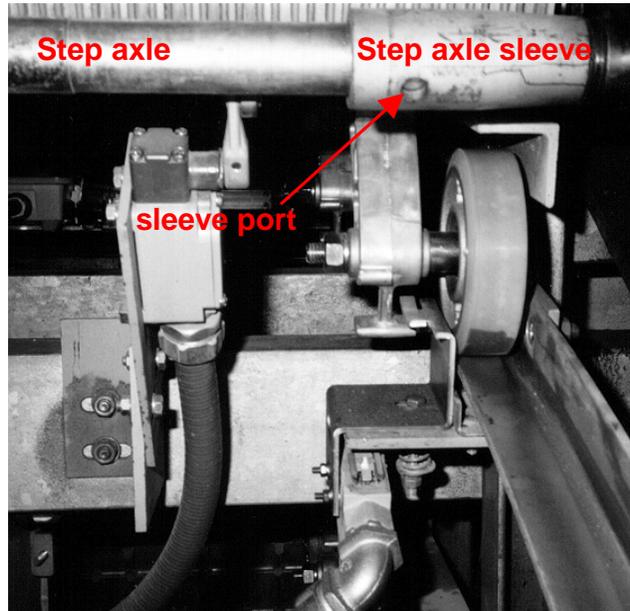
Inspect for damages on the sprocket teeth surfaces and side surfaces of teeth and engaging area.

Lubricate Step Chains (figure 8-9 p4);

- a) inner and outer links on both sides of the same chain,
- b) between links and rollers on both sides of the same chain,
- c) oil the center of the chain rollers if they have oil ports.

- d) perform the same procedures above for both LH and RH step chains.
- e) lubricate O&K step chains twice a month

Clean and lubricate LH and RH step axle sleeve ports (picture at right) semi-annually for Fujitec and Otis escalators.



Fujitec Step Axle Sleeve Port

Run the unit for at least twenty minutes for the oil to penetrate through.

Clean and wipe off any spilled oil or lubricant.

Lubricate the chain wheel axle (figure 8-9 below) of the Montgomery and Montgomery KONE whenever the axles are exposed after step removal and during chain job. Insure that the clip at the end of the chain wheel axle is installed

Never take your eyes away from the oiler hose tip while manually oiling chain.

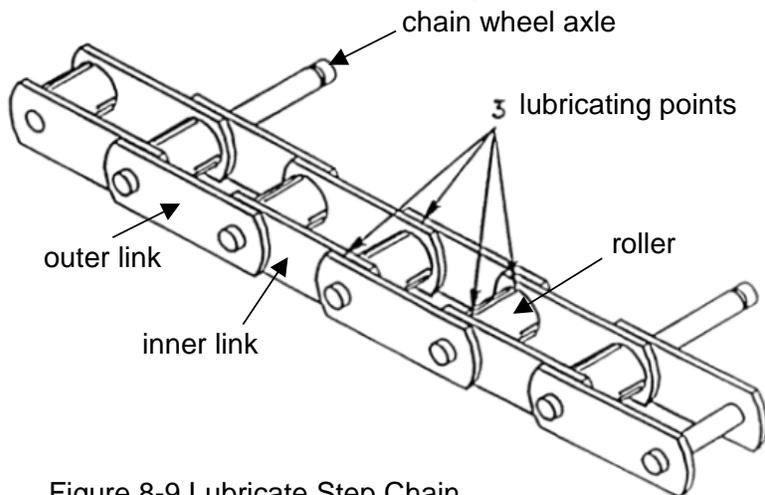


Figure 8-9 Lubricate Step Chain

B. Carriage Spring Tension for Broken Step-Chain Device Adjustment

BART Escalators Carriage Spring Tension Measurement

Fujitec = 5 ¾ inch	Montgomery KONE = 12 ¾ inch
O & K = 3 ¾ inch (95mm)	Montgomery = 12 ¾ inch
Otis = 4 ¾ inch	Westinghouse = 8 1/8 inch

Remove three to five steps but no more than six consecutive steps.

Clean and adjust lower carriage spring tension and broken step chain switch. Best result is attained after step chain lubrication.

Clean, inspect and lubricate rail bars, guide wheels and sliding blocks.

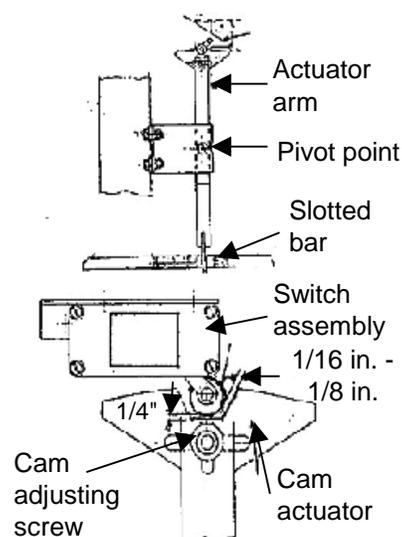
All BART escalators are equipped with two broken step chain tension springs except Westinghouse escalator.

Set step-chain tensioner on both sides of the escalator so the tensioning axis is at right angles to the step-belt.

Westinghouse Escalator Carriage Spring Tension at 8 1/8 inch.

- Before tensioning the spring, ensure that the ¾ inch tension rod (figure 8-9b item 6) is fully secured.
- Adjust the spring. Check the carriage shaft to be **no less than ¼ inch against the inner circle tracks and of equal distance on both sides**. Step chain replacement is due if less than ¼ inch or unequal.
- Adjust the broken step chain safety device (figure 8-9a at right) cam against the switch roller to **1/16 inch - 1/8 inch** on the uphill side for;

The switch should trip when the step chain pulls toward the bull gear caused by step jammed against the combs.



1/16 in. to 1/8 in. - clearance between cam & roller on the uphill
1/4 in. - clearance between roller & inside of the cam

Note that the actuator arm moves back with the carriage for normal step chain wear.

Montgomery Escalator Carriage Spring Tension at 12 3/4 inch.

- Turn the jam nut (item 8 figure 8-9c) to set spring tension.
- Adjust broken step chain switch by loosening the switch and setting the switch plunger perpendicular and centered to the actuator (beveled hub for older Montgomery).

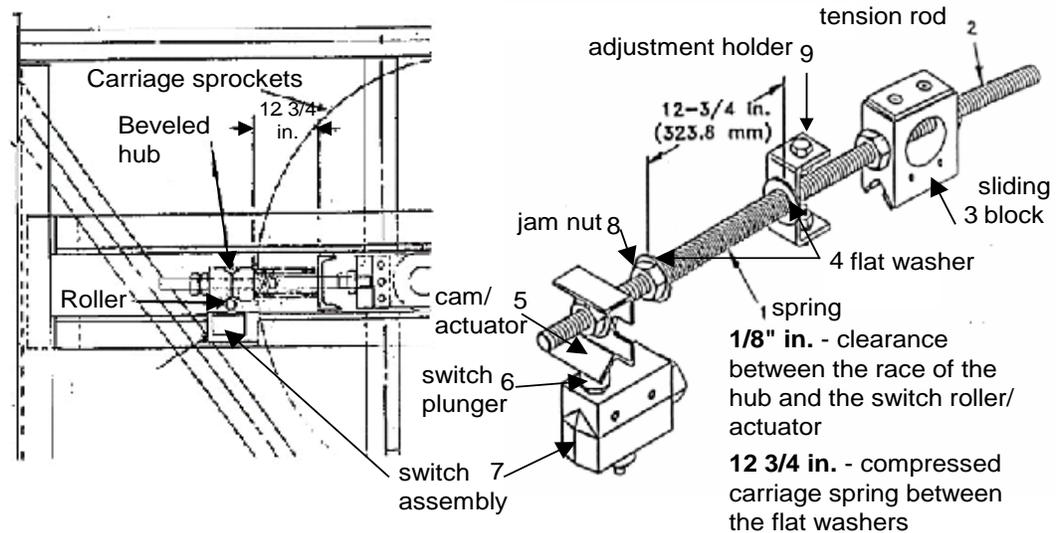


Figure 8-9c Montgomery and Montgomery KONE Carriage Spring

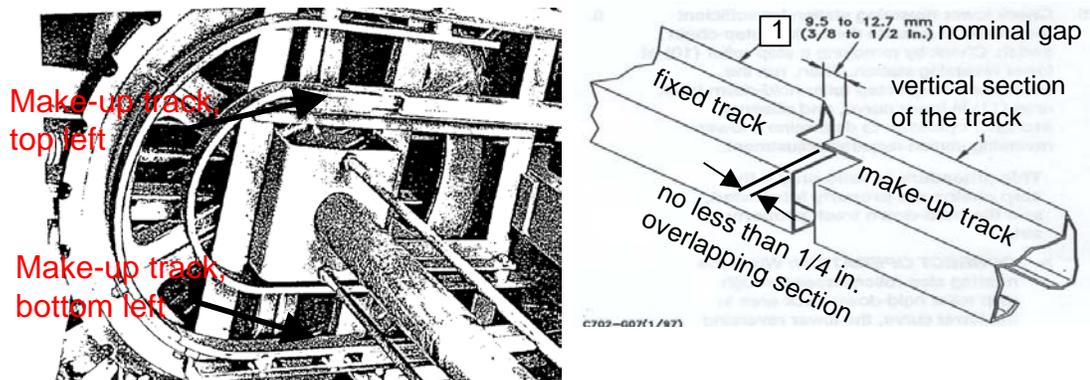


Figure 8-9d Montgomery & Montgomery KONE Make-Up Tracks

- Inspect the make-up track for step chain wear and alignment with fixed track.
- Check for a nominal gap of 3/4 inch between fixed track and make-up track. If the gap has increased beyond 3/4 inch so the overlapping section of fixed track and make-up tracks is less than 1/4 inch, check for step chain elongation and/or replace make-up track. Inform your Foreworker that the step chain may be due for a chain job.

O&K Escalator Carriage Spring Tension at 3¾ inch (95mm).

- Adjust limit switch so that the roller is centered in the cam/trip bar.
- Actuate the limit switch to check its operation. The unit must not run after actuation. Reset the switch by pulling the “pull pin” in the direction of arrow on the switch.
- Inspect the guide wheels free rolling against the rail bar, the **1/32 inch** clearance between the sliding block and L-bracket. If unable to attain 1/32 in. clearance, the step chains are elongated.

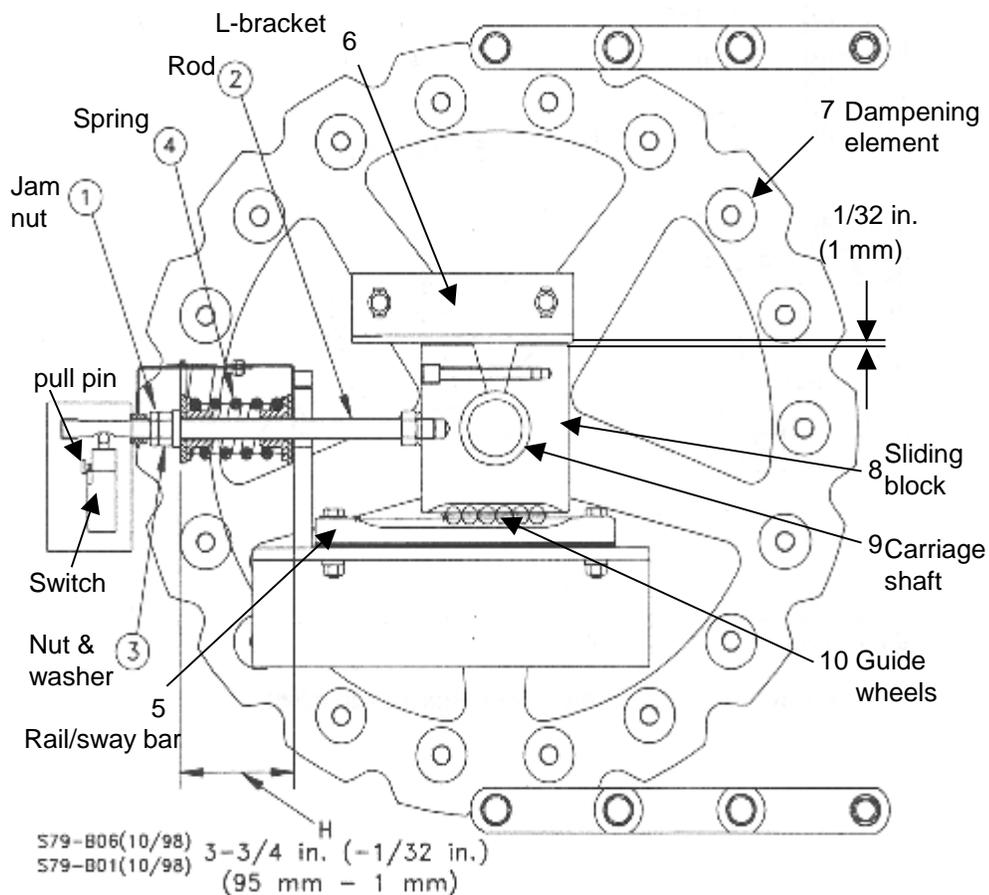


Figure 8-9e O&K Escalator Lower Reversing Station

Clean, lubricate and inspect carriage guide wheels and rails on both sides. Replace flatten guide wheels and worn rails.

Insure that the carriage sprocket teeth top landings are square with even pattern of wear, the dampening elements in place and not worn. Replace worn dampening elements.

Fujitec Escalator Carriage Spring Tension at 5 ¾ inch (figure 8-9f).

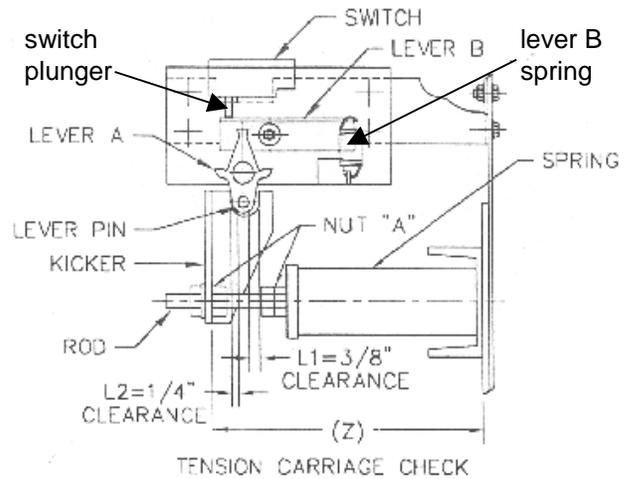
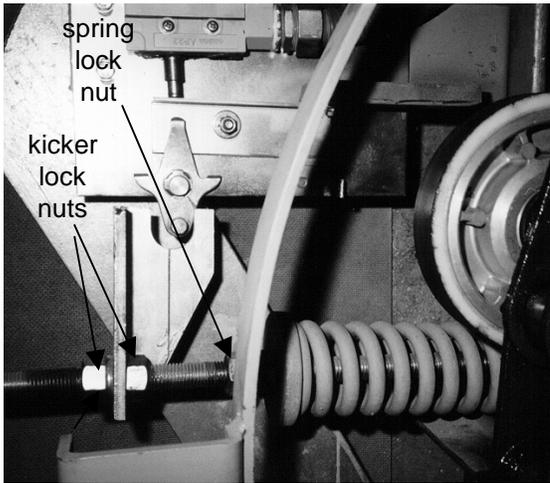


Figure 8-9f Fujitec Carriage Spring Tension

- Adjust the spring so that the clearance between the kicker plate groove and the side of lever L2 = ¼ in. ± 1/16 in. at the lower end and L1 = 3/8 in. ± 1/16 in. towards the upper end.
- Trip the switch by moving lever A from the catch off lever B. Lever B will actuate the switch. The unit must not start.
- Chain job is required if after spring tensioning you observed chain elongation;

The kicker inside locknut reaches the spring adjusting nut.

Both step chains rollers rides high on the sprockets teeth and not on the grooves.

The step chains are found to be of different length causing an improper indexing to be noticeable.

- Set Fujitec PS-S 1200 switch actuator in the middle of the kicker cam.

Otis Escalator Carriage Spring Tension at 4¾ in. (figure 8-9g). Otis carriage spring tension adjustment is similar to Fujitec escalator.

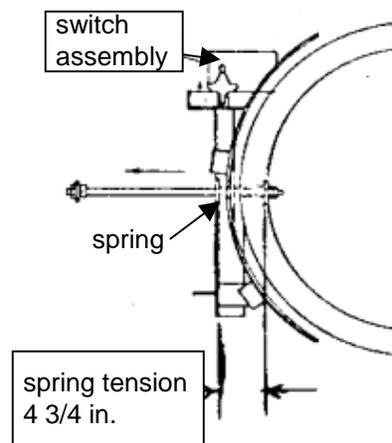


Figure 8-9g Otis Escalator Step Chain Tensioner

C. Clean and Inspect LRS Operation

Observe a slight shift of the **LRS** during start up and **free moving** (oscillation) in normal run with any change of load in the stepband. **Observe the step chains to be riding squarely on the carriage sprockets.**

If the LRS does not oscillate and/or the step chain does not ride squarely on the carriage sprockets, place the escalator on inspection and remove three to five steps but no more than six.

Clean and inspect the carriage shaft bearing for evidence of wear. Inspect the shaft to be in plane. If not in plane, the bearings or the guide wheels may be worn.

Remove drain plugs and clean zerk fittings to lubricate the bearings. Avoid over-lubrication not to break the oil seal. Clean and inspect old grease from the drain for any contamination. Replace worn bearings.

Replenish tension carriage bearings grease (figure 8-9h below) every 3 years for Fujitec, O&MM Section 7 p21/35.

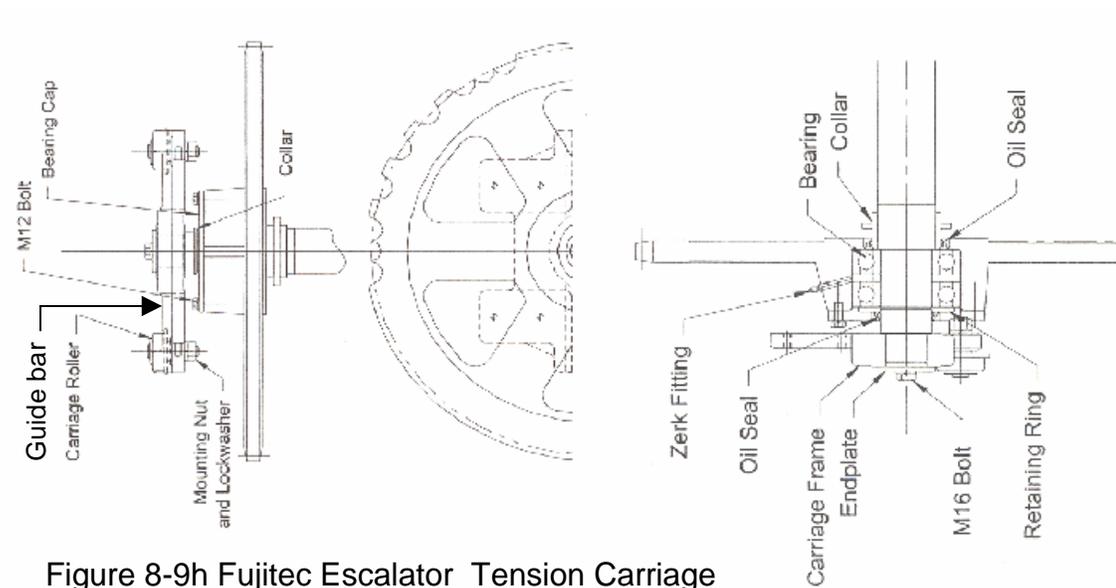


Figure 8-9h Fujitec Escalator Tension Carriage

Clean, inspect, and lubricate guide wheels and sway bars. Replace flatten rollers or guide wheels.

Westinghouse and Fujitec escalators; slightly lift carriage off the sliding bar at one end to turn wheels flat spot $\frac{1}{4}$ turn away from you. Insure that the wheels spin freely. Perform the same on both sides.

If wheels failed to spin freely, inform your Foreworker for carriage wheels replacement. Replace all wheels when one is defective.

Clean and inspect sliding or sway bar underneath the guide wheels for wear. Inform your Foreworker if the sliding bar needs replacement. Replace both sliding bars when one is defective.

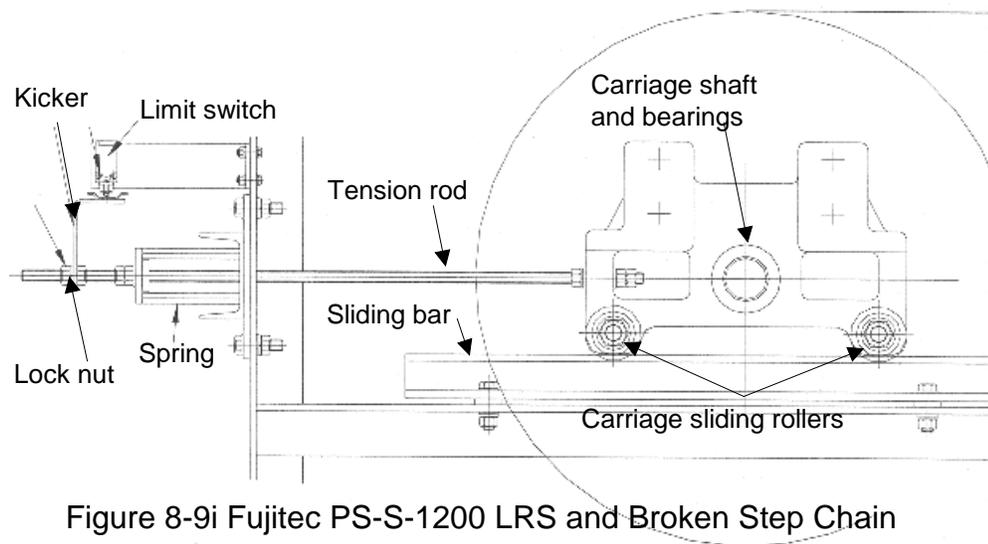


Figure 8-9i Fujitec PS-S-1200 LRS and Broken Step Chain

Inspect the **carriage sprockets teeth** for wear.

If evidence of wear start to appear, this may be caused by any or combination of the following;

- uneven step chain length,
- worn out main drive shaft or carriage shaft bearings,
- worn out carriage guide wheels or sliding bar.
- lack of step chain lubrication

Inform your Foreworker for carriage replacement if the sprocket teeth are badly worn.

Clean and wipe off any spilled oil or lubricant.

D. Clean Step Demarcation & Combplate Light Covers

Insure that the demarcation lamps are ON during normal operation.

But the combplate lights should always be ON.

Remove five steps to access the demarcation lights and the drip pan below it.

Move missing step above step demarcation light at the bottom landing.

Tagout and lockout the circuit breaker, turn off Pit Stop switch and Remote Control.

Clean lamp covers and replace burnt lamps.

Insure that the step demarcation lamp covers and/or the lamp sleeves are green in color and visible from the step separation at both step entrances for passenger safety.

Replace lamps annually or every 10,000 hours of operation regardless if they are burned or not. This will insure the long life of the ballast and the starters.

Clean the drip pan and the tracks around the lower carriage.

Move missing step above the upper landing demarcation lights to perform the same procedures above.

Reinstall the steps and return the escalator to service.

REVIEW QUESTIONS; Write your name and answer in separate piece of paper.

1. What is the distance between the switch roller and inside of the cam towards the top landing of Westinghouse escalator? _____ inch.
 - a) $1/16 - 1/8$
 - b) $1/8 - 3/16$
 - c) $3/16$
 - d) $1/4$
2. What is the purpose of making the adjustment in question 1 above?
3. How would you know if the step chain of Montgomery escalator is due for chain job?
4. What is the spring tension measurement of Fujitec escalator?
5. Where would you measure the step chains of Westinghouse escalator if chain job is due?
6. Name three indications that a Fujitec escalator carriage sliding roller is flatten?
7. How often are the Fujitec escalator carriage bearings replenished?
 - a) Quarterly
 - b) Semi annually
 - c) Annually
 - d) Every 3 years
8. What is the carriage spring tension set at for Otis escalator? _____ inch.
 - a) $3 \frac{3}{4}$

- b) 4 $\frac{3}{4}$
- c) 5 $\frac{3}{4}$
- d) 8 $\frac{1}{8}$

FIELD PRATICAL, SKILL TEST, Perform;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Demonstrate how to;

- 1. Access Westinghouse LRS to inspect and to lubricate carriage bearings.**
- 2. Turn carriage rollers of the Westinghouse escalator.**
- 3. Inspect Montgomery escalator step chain wear.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

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Unit 10: Lower & Upper End Pans, Tracks, and
Upthrust Safety Device

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Ride the trailing step behind the open stepband.

Lower & Upper End Pans, Tacks, and Upthrust Safety Device

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to;

- Demonstrate how to access and inspect tracks of step and chain wheel.
- Identify defective step tracks.
- Clean, inspect and set clearances of Upthrust Safety Device for; Fujitec, Montgomery, Otis. O&K and Westinghouse.

A. Lower & Upper End Pans, Step & Chain Wheel Tracks; Clean & Inspect

Run the unit to examine the alignment of the steps between skirt panels. Ride the steps and check for;

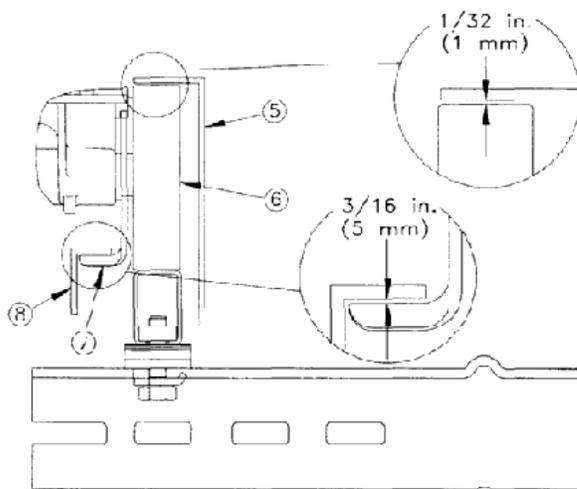
- Any or all steps that may shift side to side due to misaligned tracks (chain guide for O&K).
- All step and/or chain wheels appear to drop down in a certain spot on the track which may indicate worn or broken track.

Remove 5 steps to access the LRS. Place the inspection switch to "INSPECT". Use pendant control to operate the unit.

- If more than six steps is to be removed, install dummy axles if available or a step for every sixth steps to contain the step chains within the tracks.
- Clean debris and foreign materials in the **lower end pans up to 30 degree incline**. Dispose of waste according to governing regulations.
- Clean and inspect all track rails for wear, uneven joints, misaligned, broken, or loose fastener.
- Insure all track hardware and fasteners are secured.
- Move missing stepband at the **upper end to clean pans down to 30 degree incline**. Dispose of waste according to governing regulations.

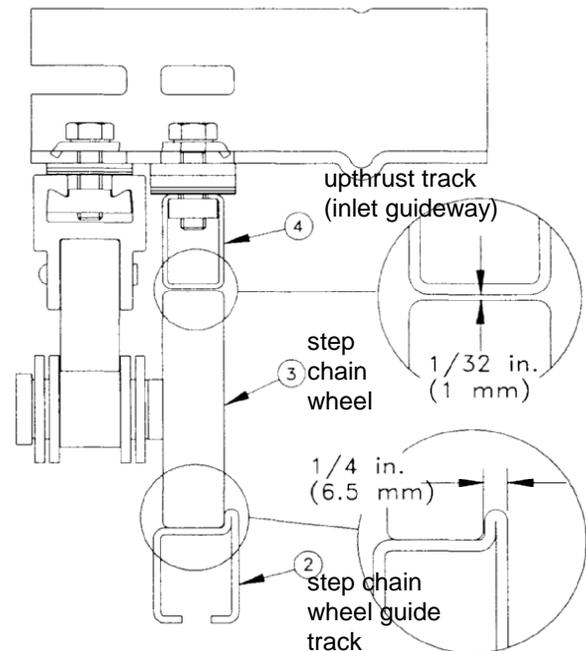
Move the open stepband at the LRS to position the leading step above the **step chain wheel upthrust track** for step chain wheel clearance inspection.

- Ride the trailing step above the step wheel upthrust track.
- With your weight on the step, inspect the step and chain wheels clearances against the upthrust tracks (figure 8-10) to **1/32 in. or 1 mm**.
- Spin the step trail wheels (item 6 below). The **wheels should spin slightly free and the step should NOT rock front to back excessively**.
- If the step trail wheel does not spin, inspect the wheel for wear and the track for proper clearance adjustment.
- If excessive step rocking is noted, **adjust upthrust track to 1/32 in. (1 mm) clearance from the wheel**.



S79-B05(10/98)
 5 - inlet guideway track
 6 - step trail wheel
 7 - step wheel lug (upthrust)
 8 - upthrust track bar

Figure 8-10 O&K Step Chain Wheel Upthrust Clearance



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Figure 8-10a O&K Chain Wheel Upthrust Clearance

Adjust the **step chain wheel upthrust** (figure 8-10a) similar to step trailing wheel upthrust.

Access and inspect **return upthrust** (items i & j respectively, figure 8-10b below) for the chain wheel and step trailing wheel to be **1/32 in. (1 mm)**.

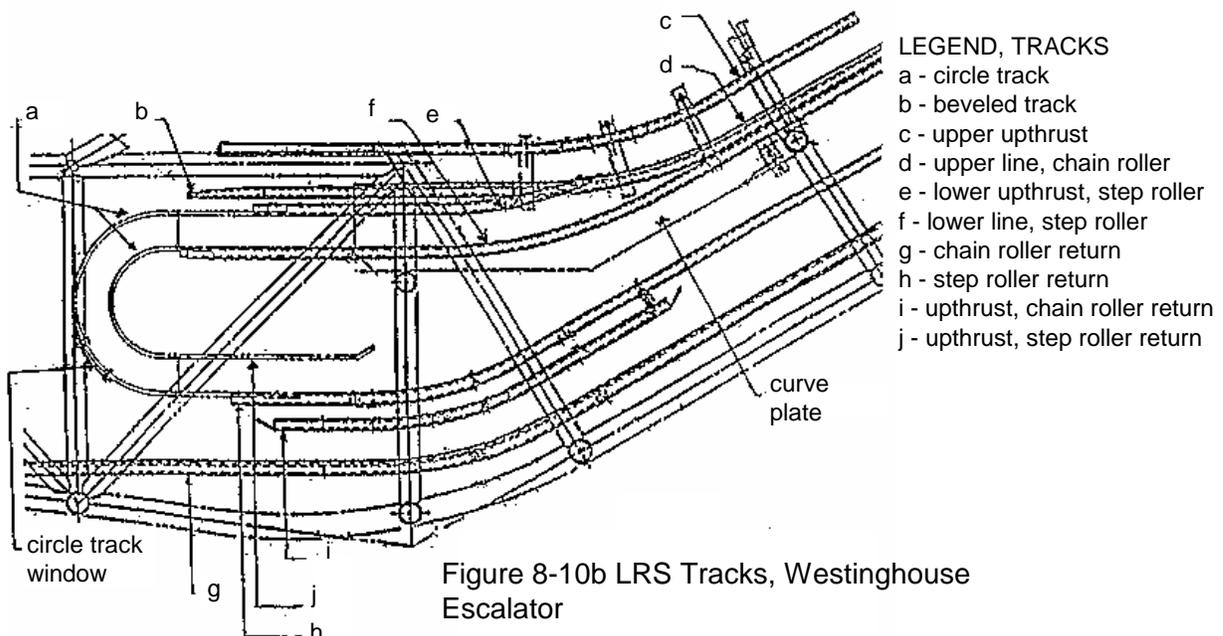
- The wheels should spin with minimal tension. If wheels are hard to spin, inspect wheels for wear and or adjust track.
- Inspect all hardware fasteners to be secured.
- Replace worn track in section. **Never weld tracks against the truss or brackets.**

B. Clean, Inspect & Test Operate Step Upthrust Safety Device

NOTE: If the step hooks are worn and shinny, they are sliding against the step upthrust track and the upthrust safety device is inoperable.

The operation of the upthrust devices are tested as follows:

- With the escalator running down, grab the step riser with a channel lock to **apply an upward force** to a step to resist leveling as it enters the lower curve. This should pull the upthrust safety to **stop the escalator**.
- If this will not operate the upthrust safety, internal inspection is required.



Westinghouse Upthrust Safety Device; Clean, Inspect and Adjust.

Access LRS and remove three steps. Move the open stepband above the step upthrust safety assemblies (figure 8-10f p8).

Clean and inspect **front and back sliding guide plates** at both ends of the upthrust track (figures 8-10c & 8-10d below), the **lever** (figure 8-10e p7), and **upthrust track assemblies**. The sliding guide plates should move freely. **Clean and lubricate all pivot points, front and back of guide plates.**

Set guide plates clearances at $\frac{1}{32}$ in. to $\frac{1}{64}$ in. from the track trust to insure they move up and down freely, see figure 8-10f Note 3 in p8.

Move the open step band with the leading step trailing wheel below the **safety guard bars top end.**

- With your body weight on the leading step, adjust LH and RH jack screw "c" (figure 8-10d below) to attend $\frac{1}{16}$ in. **clearance between the safety guard bar and step "T" bar.**

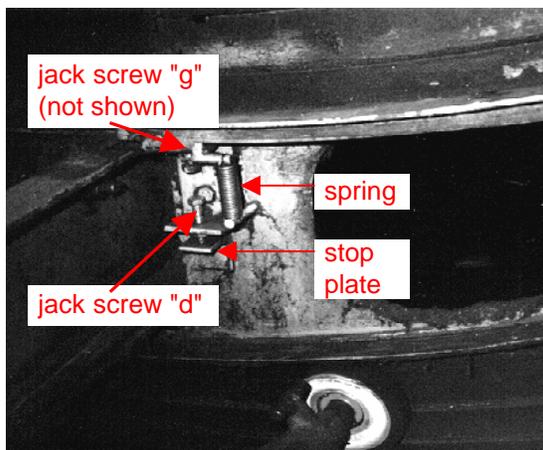


Figure 8-10c Bottom left upthrust guides

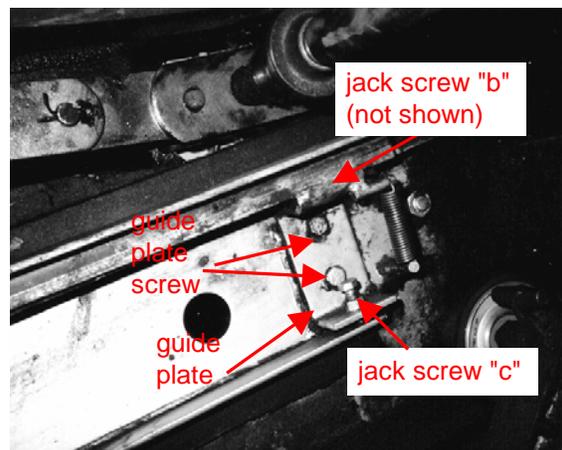


Figure 8-10d Upper left upthrust guides

Move the leading step to the **safety guard bars bottom end.**

- Perform the same adjustment procedures as the upper safety guard bars by adjusting jack screw "d" (figure 8-10d above).

Move the open step band above the safety guard assemblies.

Set $\frac{1}{4}$ x 20 jack screws “b” & “g” (figure 8-10f p8) clearance at both ends of the guard bar to $\frac{3}{8}$ in. The **switch should actuate** before the guard bar reaches its **maximum lift of $\frac{3}{8}$ in.**

Loosen two 10-32 in. screws to set the **lever** (figure 8-10e at right) to $\frac{1}{32}$ in. against the switch plunger.

The unit must not start after each switch actuation. Reset the MMI/Controller.

Test the upthrust safety device for proper operation.

- Move the leading step above the upper end of the safety guard assemblies.

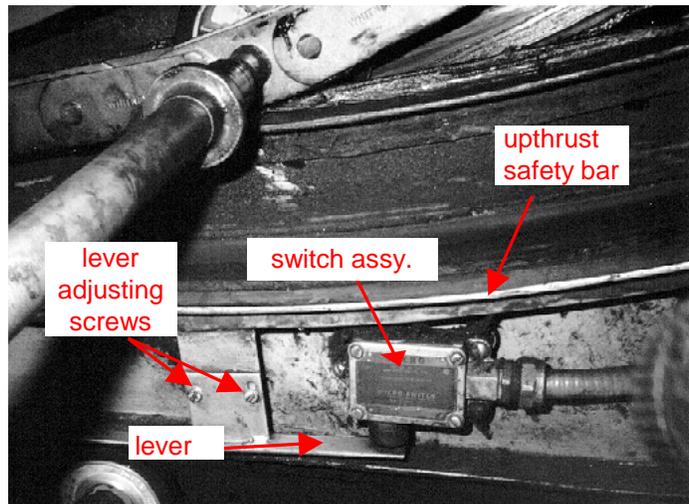


Figure 8-10e LH Upthrust Safety Device

- Lift leading step riser until both LH and RH safety guard bars are lifted to $\frac{1}{4}$ in. or more by the **step hooks**. The actuator should actuate the switch. If not, readjust the actuator bar and/or inspect the cause of the problem.
- The spring will hold down the upthrust track after the safety guard bar is moved. If not, check any binding mechanism.
- Perform the same at the bottom end of the safety guard bars.
- Reinstall all the steps to test upthrust safety device.
- Run the unit to one revolution to check the clearance between the LH and RH step hooks and the safety guard bars. Insure that none of the step hooks will strike the safety guard bars.
- Run the unit in the opposite direction to observe similar operation above.

Reinstall cover plates and return the escalator to service.

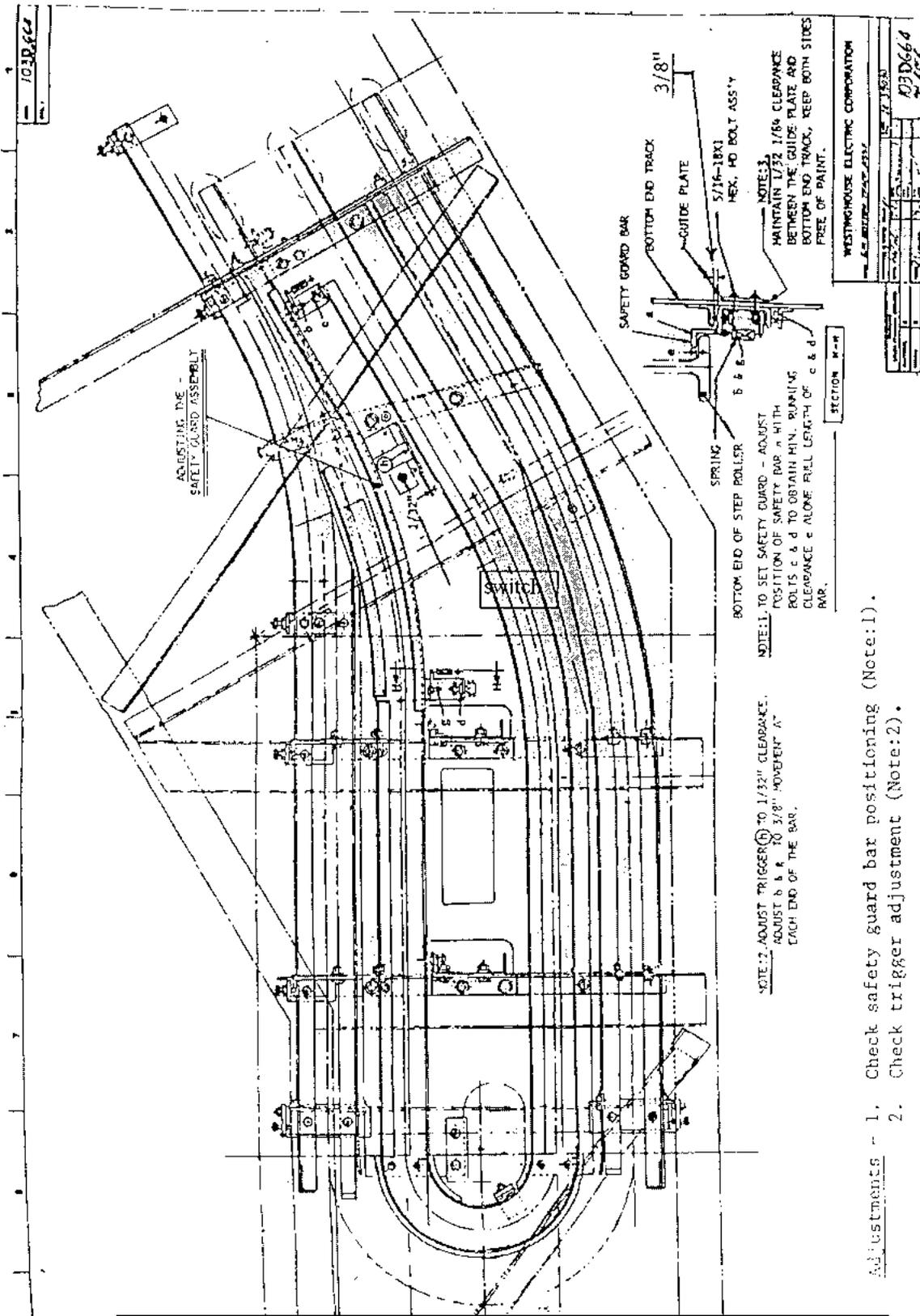


Figure 8-10f Westinghouse Escalator Uphrust Safety Device

- Adjustments - 1. Check safety guard bar positioning (Note:1).
 2. Check trigger adjustment (Note:2).

Dimension "e" = 1/16"

ESC switch should actuate when nosetrack is lifted about 1/4" at either end of track.

WESTINGHOUSE ELECTRIC CORPORATION

DATE	BY
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MMontgomery KONE & Montgomery Upthrust Safety Device

Access the LRS and remove three steps.

Move open stepband above the upthrust safety assemblies to clean, lubricate and inspect upthrust safety devices mechanism.

- Insure that all mechanism shall move freely and the unit will not start either using a remote control or in automatic operation when the upthrust safety switch is actuated.
- Insure that the spring will hold down the upthrust track after the step wheel bar is moved.

Montgomery KONE is equipped with lower and upper end upthrust safety devices.

- Perform adjusting procedures as described in figure 8-10g page 10 for the upper end and figure 8-10h page 11 for the lower end.

Montgomery upthrust safety device is at the lower incline only.

- Move the leading step trailing wheel bar below the upthrust bar.
- With your weight on the step measure the clearance between the step bar and the upthrust bar to be $\frac{1}{32}$ inch.
- The step upthrust safety switch will actuate when the upthrust track is displaced (pulled up) by $\frac{1}{16}$ inch.

Install all the steps back and test run the unit.

- Run the unit to one revolution to check the clearance between the LH and RH step hooks and the safety guard bars. Insure that none of the step hooks will strike the safety guard bars.
- Run the unit in the opposite direction. Observe the same operation as above.

Reinstall the cover plate and return the unit to service.

Adjusting procedures

Adjusting upper end upthrust safety switches

1. Barricade both ends of the escalator, and remove access covers.
2. Remove three steps, and position hole in step band above upper end step upthrust safety switch.
3. Turn mainline disconnect OFF.
4. Make sure upper end trailing wheel hold-down track (1) is adjusted properly. If adjusted correctly, hold-down track should have approximately 1/32 inch [0.8 mm] clearance to trailing wheels.

For more information on trailing wheel hold-down track, refer to UPPER END TRACK & NOVATEX BOARDS/Adjusting procedures/ Hold-down track.

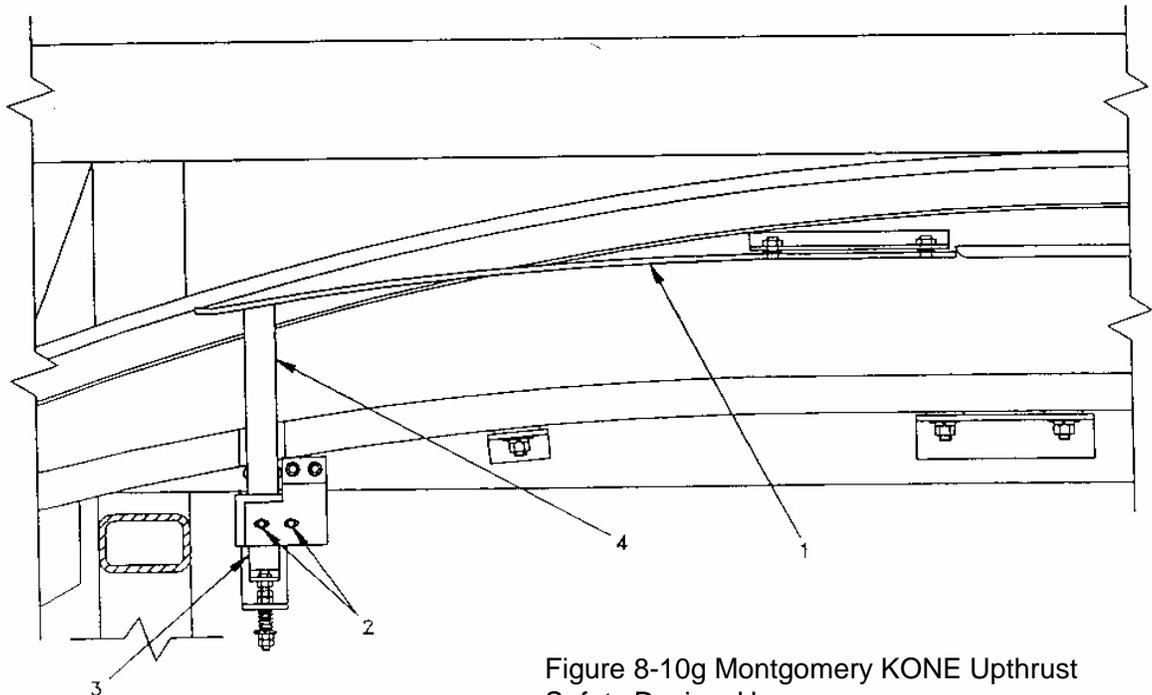
5. Loosen switch mounting screws (2).

6. Adjust switch (3) to actuate when switch actuator (4) moves 1/16 inch.
7. Tighten switch mounting screws.
8. Make sure switch actuates properly.

The step upthrust safety switch should actuate when the hold-down track is displaced 1/16 inch [1.5 mm], and automatically reset when the hold-down track springs back to its proper position.

9. Replace steps and access covers.

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Figure 8-10g Montgomery KONE Upthrust Safety Device, Upper



Adjusting procedures

STEP UPTHRUST SAFETY SWITCH

The following describes adjusting procedures for *lower end step upthrust safety switches* and *upper end step upthrust safety switches*.

Adjusting lower end upthrust safety switches

1. Barricade both ends of the escalator, and remove access covers.
2. Remove three steps, and position hole in step band above lower end step upthrust safety switch.
3. Turn mainline disconnect OFF.

4. Make sure lower end trailing wheel hold-down track (1) is adjusted properly. If adjusted correctly, hold-down track should have approximately 1/32 inch [0.8 mm] clearance to trailing wheels.

For more information on trailing wheel hold-down track, refer to LOWER REVERSING STATION & TRACK/Adjusting procedures/Hold-down track.

5. Loosen switch bracket mounting bolts (2), and position switch actuator (3) centered on keystone (4), and tighten switch bracket mounting bolts (2).
6. Loosen switch mounting screws (5), and adjust switch (6) up or down until switch actuates when hold-down track (1) is displaced 1/16 inch [1.5 mm].
7. Tighten switch mounting screws (5), and make sure switch actuates properly.

The step upthrust safety switch should actuate when the hold-down track is displaced 1/16 inch [1.5 mm], and automatically reset when the hold-down track springs back to its proper position.

8. Replace steps and access covers.

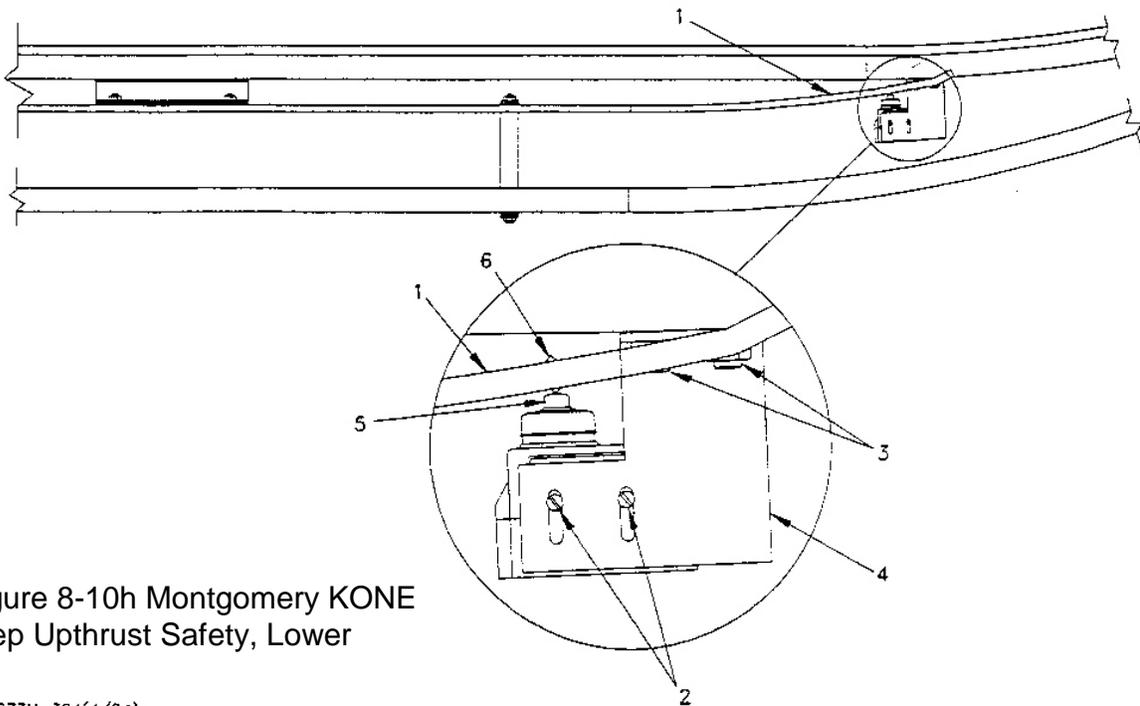


Figure 8-10h Montgomery KONE Step Upthrust Safety, Lower

S73H-304(4/94)

O&K Upthrust Safety Device (figure 8-10i below)

Access the LRS and remove three steps.

Move the open stepband above the upthrust safety device (Step Lift Monitor by O&K).

Clean and inspect both LH and RH upthrust safety devices.

Lubricate the space between the lift (guideway) and the trail wheel track.

Insure that the lift moves freely against the trail wheel track and the spacer block will pull it back in place.

Move the leading step above the lift with the counter guide lug as shown in figure 8-10i below.

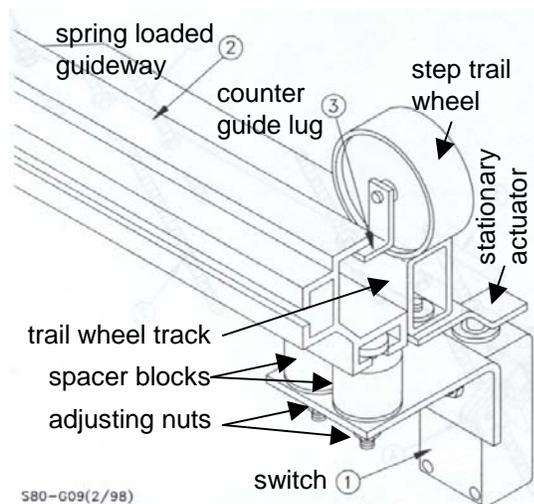


Figure 8-10i O&K Step Lift Monitor

- With your weight on the step, use the adjusting nuts to attain LH and RH clearance of the step counter guide lug against the upthrust to $\frac{3}{16}$ inch (figure 8-10j p13).
- Set the **switch plunger against the actuator bar** to $\frac{1}{32}$ in. (figure 8-10j p13). The switch shall actuate after the step lift monitor is lifted to $\frac{15}{64}$ inch. The unit must not start until reset switch is reset.

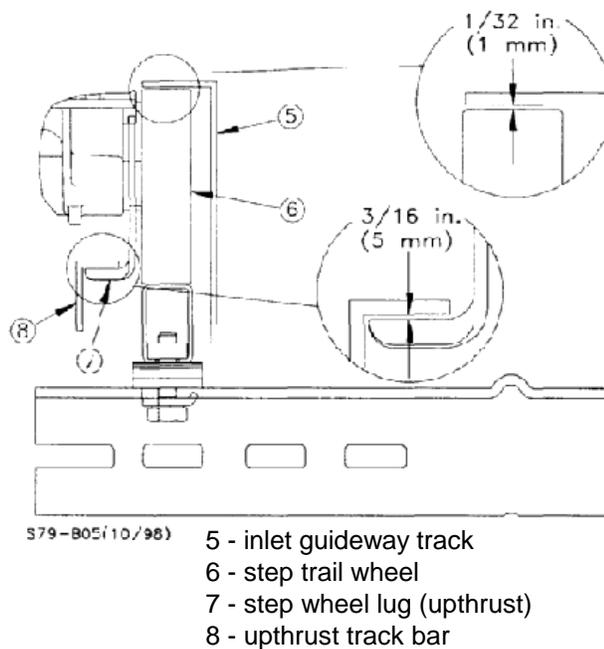


Figure 8-10j O&K Step Chain Wheel
Upthrust Clearance

Move leading step above the upper end of the upthrust track bar.

- Adjust the upper end of the upthrust bar similar to the lower end.

Install all the steps back and test run the unit.

- Run the unit to one revolution to check the clearance between the LH and RH step hooks and the safety guard bars. Insure that none of the step hooks will strike the safety guard bars.
- Run the unit in the opposite direction. Observe the same operation as above.

Reinstall the cover plate and return the unit to service.

Fujitec Upthrust Safety Device

Access the LRS and remove three steps. Move missing step above the upthrust safety device.

Clean, inspect and adjust upthrust safety devices both LH and RH at the upper and the lower incline.

Clean and lubricate the sliding part between guide and bracket (figure 8-10k).

Move leading step trailing wheel above the upthrust track bar.

- With your body weight on the step, set the clearance between the step T-bar and the upthrust track bar to **.12 in.** or slightly below **1/8 inch**.
- To set the clearance, loosen spring and add or remove shims between the guide and the bracket.

Adjust switch plunger against the bracket to **1/16 inch**.

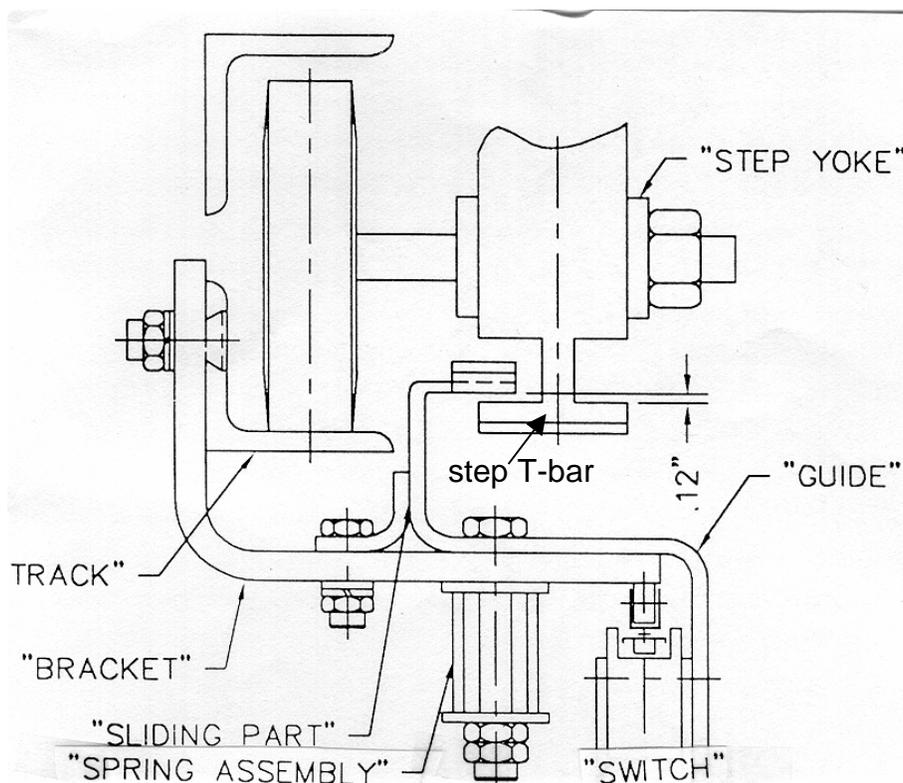


Figure 8-10k Fujitec LH Upthrust Safety Device (step safety sw.)

Test the step upthrust by lifting the step. The switch should trip and the unit must not start either with the remote control or in normal operation. The spring shall pull the guide back in place.

Move missing step above the upper incline LH and RH upthrust safety device (figure 8-10I below).

Perform the same procedures as described at the lower upthrust safety device.

Reinstall the steps, run the unit for one revolution to test operate step upthrust safety device. Insure that both LH and RH step T-bars are clear off the upthrust tracks.

Perform the same procedure above in the opposite direction of travel.

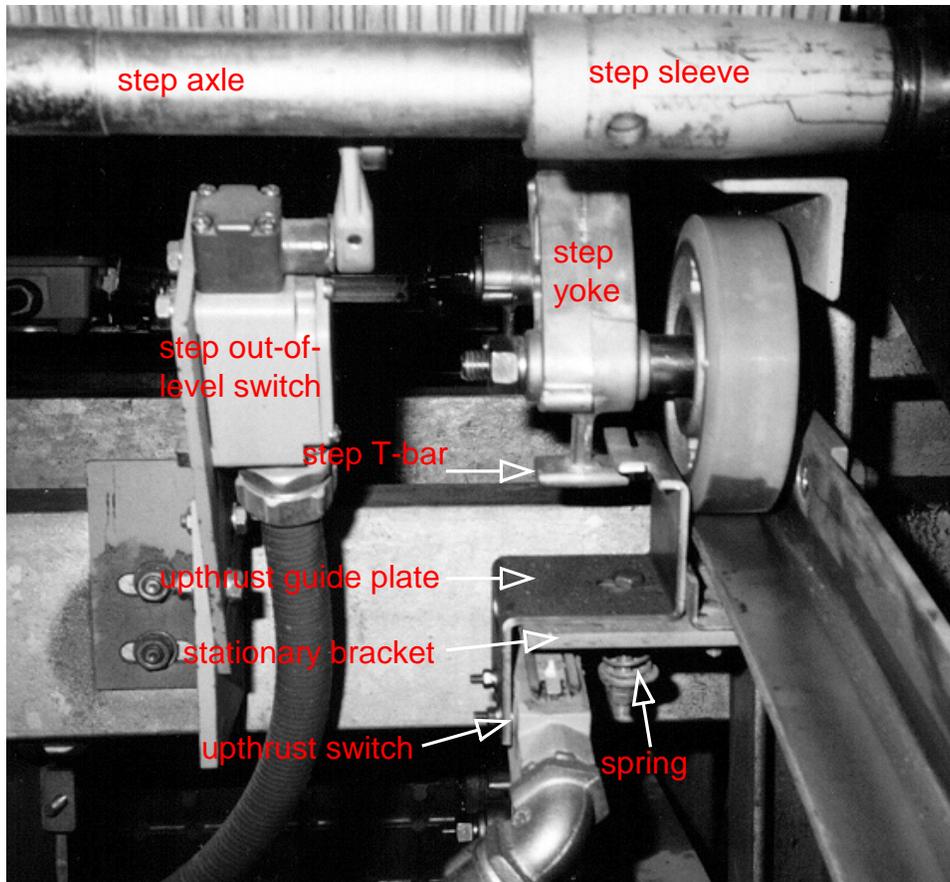


Figure 8-10l Fujitec Upper RH Upthrust & Out-of-Level Safety Devices

Fujitec PS-S 1200. Set clearance between the step yoke T-bar and the switch roller lever to $\frac{1}{4}$ inch.

Otis Upthrust Safety Device or Step Safety Switch (figure 8-10m below)

Access LRS and remove three steps. Move the open stepband above the upthrust safety devices at the lower incline.

Clean, lubricate and adjust both LH and RH upthrust safety mechanisms.

Move the leading step above the bottom end of the upthrust track.

- With your weight on the step, set the gap between the step yoke T bar against the upthrust track to be .12 inch (less than 3/8 inch).

Step Safety Switches

110-11361

The step safety switches are arranged beneath the bottom of the upper line trailer wheel track. If an object gets jammed between the front of a down traveling step and the back of the previous step, the escalator will be stopped.

Setting: Refer to sketch.

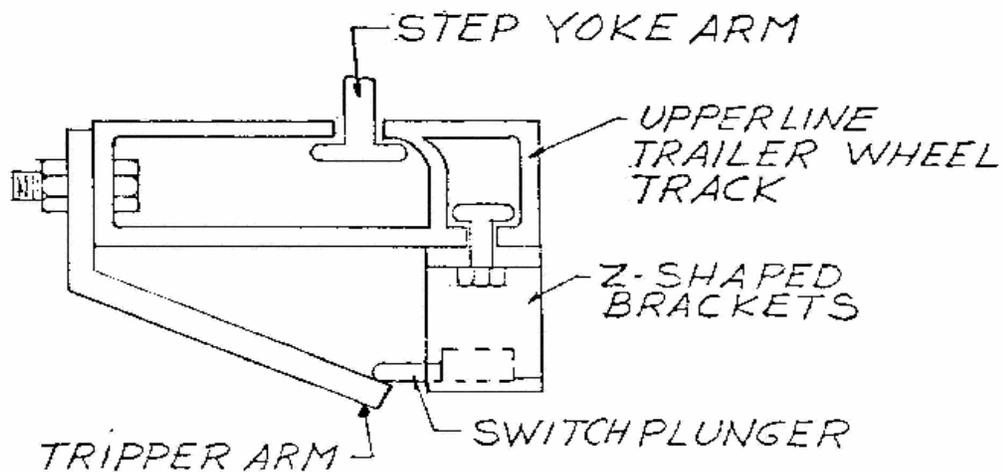


Figure 8-10m Otis Upthrust Safety Device (step safety switch)

- **Adjust tripper arm so that the upward deflection of the upthrust track will cause the switch to compress from 1.02 mm to 1.14 mm (.040 to .045 in. \cong 3/64 in.) before the normally closed contacts opens.**

Reinstall the steps. Run the unit in normal operation for one revolution to observed step upthrust safety device. Insure that both LH and RH step T-bars are clear off the upthrust tracks. Perform the same procedure in the opposite direction.

REVIEW QUESTIONS: Write your name and answer in a separate piece of paper.

1. Westinghouse upthrust actuator bar against the switch plunger is _____ inch.
 - a) 1/16
 - b) 3/16

- c) $1/32$
 - d) $3/32$
2. Westinghouse sliding guide plate for the step upthrust safety device must have a clearance of _____ inch to move freely.
- a) $1/32$
 - b) $3/32$
 - c) $5/32$
 - d) $3/64$
3. O&K inlet guide track and the step trailing wheel clearance is ___ inch.
- a) $1/32$
 - b) $3/16$
 - c) $1/8$
 - d) $1/4$
4. Montgomery KONE upper end upthrust safety device hold down track clearance to the trailing wheels must be set at _____ inch?
- a) $1/32$
 - b) $1/16$
 - c) $1/8$
 - d) $1/4$
5. A broken step trailing wheel in figure 8-10m p15 will actuate ___ safety device?
6. Westinghouse escalator broken step hooks are used to actuate _ safety device.
- a) Upthrust
 - b) Out-of level
 - c) Comb impact
 - d) Step chain
7. O&K step chain wheel upthrust clearance is set at?
8. Fujitec step "T" bar is adjust at _____ inch against the upthrust guide?

FIELD PRACTICAL SKILL TEST

Perform Preventive Maintenance of the upthrust safety device and demonstrate how to test operate;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

- 1. Westinghouse**
- 2. O&K**
- 3. Fujitec**
- 4. Montgomery**

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 11: Missing Step Detector (MSD)

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Missing Step Detector (MSD)

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform PM on Fujitec, Montgomery, Montgomery KONE, Otis, O&K and Westinghouse MSD's;

- Demonstrate how to access MSD both at the LRS and top landing.
- Clean, inspect and set clearances of MSD.

A. Clean, Inspect, and Test Operate Missing Step Detector

Access LRS and remove three steps but no more than six consecutive steps.

Move missing stepband to expose, clean, inspect and to test operate MSD. Turn mainline disconnect OFF.

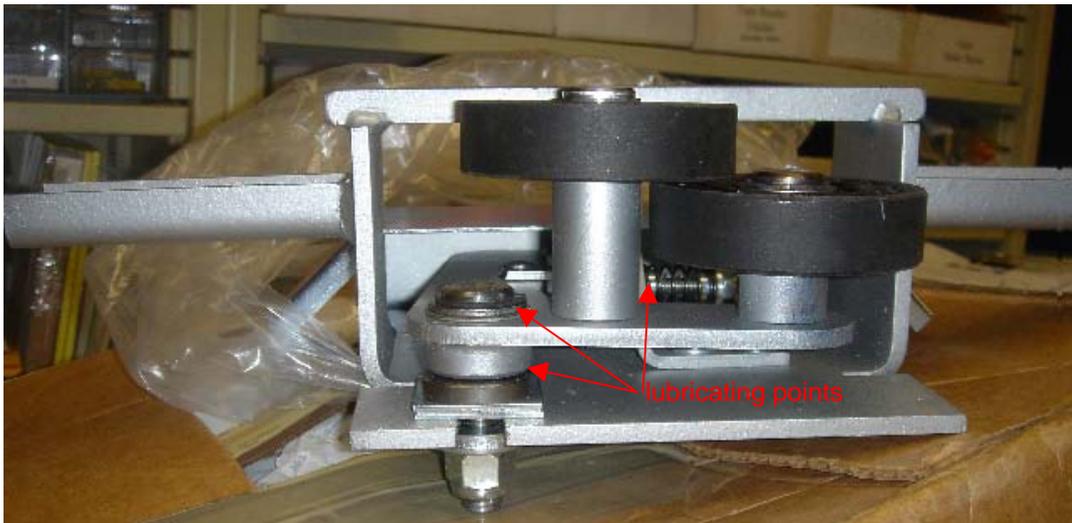


Figure 8-11 Picture of O&K Missing Step Monitor Mechanism

O&K Mechanical MSD (figure 8-11 above and figure 8-11a p4).

Remove cover of the MSD. **Clean all mechanism and lubricate all pivot points.** Inspect the wheels, wheel bearing, pins for wear, the lever should be free to pivot. Inspect the wheels to be aligned against the step tread side plates with proper spring tension. Replace defective wheels in pairs.

Insure that the tensioned spring pushes the switch lever with missing step. If not, loosen nut (5) to free the lever. Inspect all hardware and fasteners to be clean and secured.

Insure that when step tread side is pressed against the wheels, the actuator is **5/64 to 3/16 inch** off the switch. Loosen the switch mounting screws to adjust the gap if necessary.

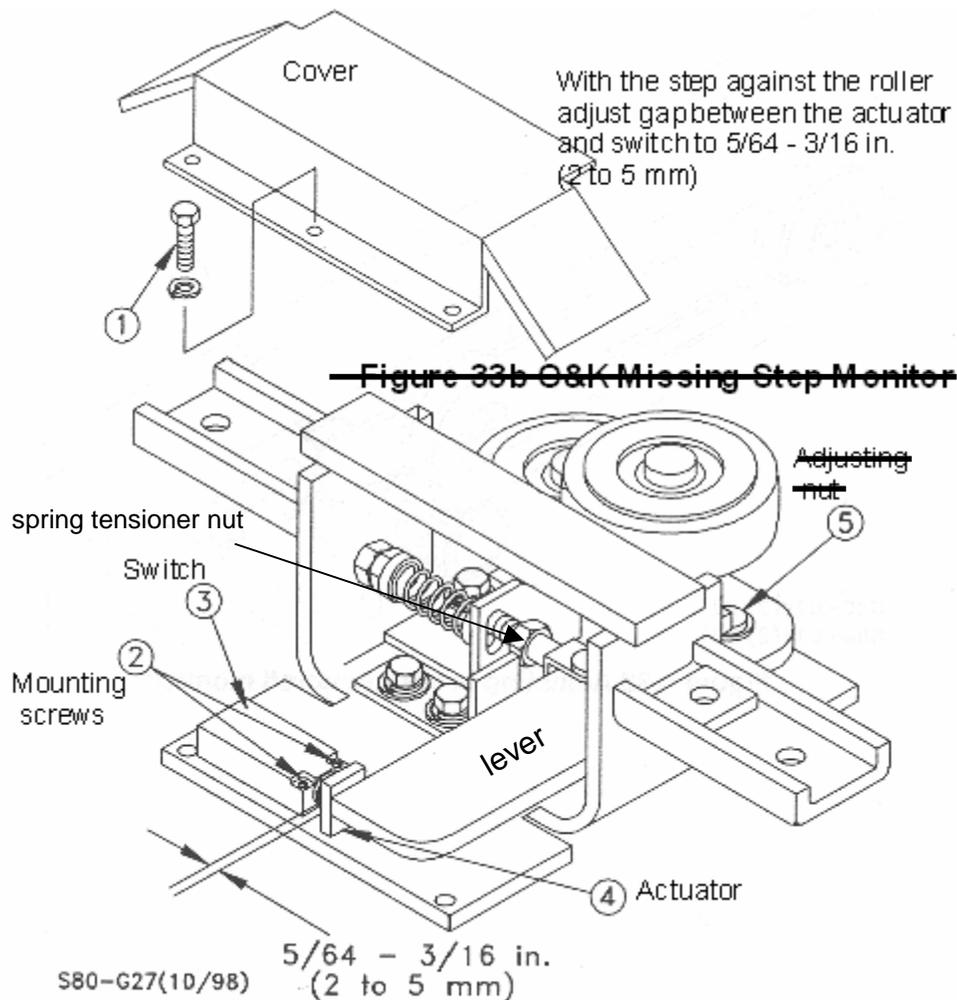


Figure 8-11a O&K Missing Step Detector

Run the escalator in normal mode of operation with missing step.

- Test the bottom landing MSD in the up travel. The unit will stop before the missing step appears at the bottom landing combs.
- Test top landing MSD in the down travel. The unit will stop before the missing step appears at the upper landing combs.

Magnetic or Inductive Proximity Sensor is used for Fujitec PS-S 1200, Montgomery KONE, Montgomery, O&K, Otis and Westinghouse escalators uses similar magnetic proximity sensor MSD.

Clean, inspect and test operate missing step detector.

Westinghouse, Otis and Montgomery LRS MSD are located on the RH side of the unit. The top landing MSD are normally installed opposite the machine.

Montgomery KONE (figure 8-11b p5)

- Remove three steps to access the MSD.
- Clean the front surfaces of the proximity or the magnetic type sensor.
- Inspect all fasteners to be secured and wires are not frayed.

Fujitec PS-ST 1200 (figure 8-11c p6).

- Remove three steps to clean and to test operate top and bottom landing MSD's.
- Clean the receiver and projector covers and lenses.
- Cover the receiver to avoid activating the bottom landing MSD and to move missing step down and away from the light axis and the combs.
- Remove receiver cover and run the unit in the up travel. The escalator will stop before the missing step appears at the bottom landing combs.
- Perform the same test procedures at the top landing.
- Inspect all fasteners to be secured.

Fujitec PS-S 1200 - when the sensor does not detect a step riser for 1.2 seconds, the circuit opens to shut down the escalator.

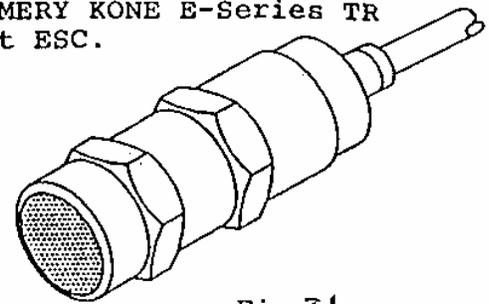
Safety concerns & equipment operation

Missing step detector

The missing step detector opens the safety circuit and shuts down the escalator if a step is missing. It is composed of two 30 MM proximity sensors (2). The 30 MM proximity sensors are mounted on the first half track brackets on the right hand lower return, and on the left hand upper return. The missing step detector is required by ANSI code to be manual reset.

73-1110 (4/95)

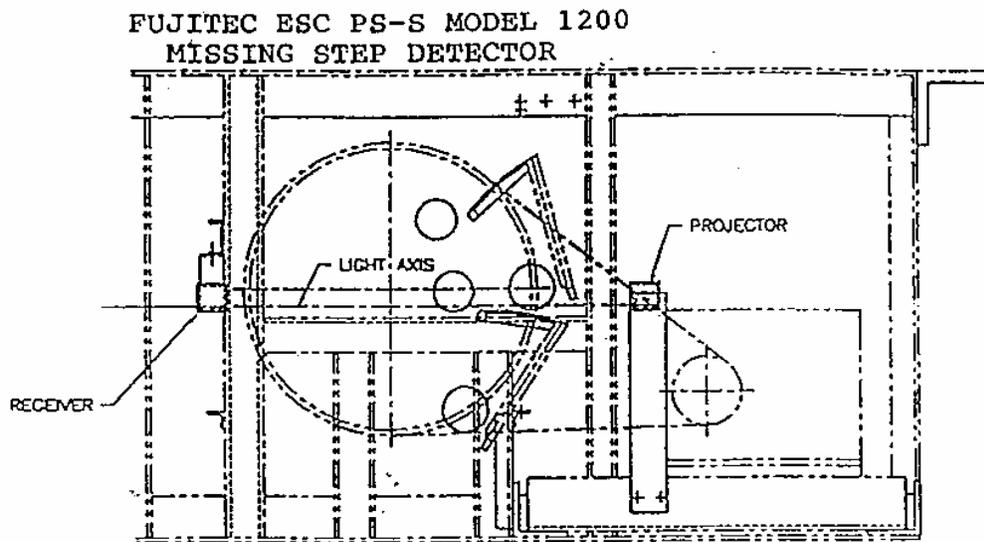
MONTGOMERY KONE E-Series TR
Transit ESC.



573H-111(4/94)

~~Fig. 31a~~

Figure 8-11b



~~Fig. 31b~~

Figure 8-11c

HOW TO ADJUST THE SENSOR

ADJUST THE PROJECTOR AND RECEIVER FACES
SO THAT THE PILOT LAMP OF THE RECEIVER IS
LIGHTED WHEN THE RECEIVER CATCHES THE
BEAM FROM THE PROJECTOR.

NOTE) ONCE EVERY 6 MONTHS, REMOVE
THE STEP. CHECK THE DEVICE
OPERATION AND CLEAN THE FACES
OF THE PROJECTOR AND THE RECEIVER
COVERS.

REVIEW QUESTIONS. Write your name and answer in a separate piece of paper.

1. Fujitec escalator is equipped with _____ MSD.
 - a) Proximity sensor
 - b) The mechanical wheel type.
 - c) Motion sensor
 - d) None of the above

2. Where would you find the bottom landing MSD of a Westinghouse escalator?
 - a) Opposite the machinery
 - b) On the same side of the machinery
 - c) RH side of the unit
 - d) LH side of the unit

3. How would a mechanical type MSD senses a missing step? The ____
 - a) wheel will move away from the open of the missing step.
 - b) wheel will move towards the open of the missing step.
 - c) magnetic sensor will sense the absence of a step.
 - d) wheel will not move towards the open of missing step.

4. How often would you perform PM for the MSD?
 - a) Monthly
 - b) Quarterly
 - c) Semi-annually
 - d) Annually

5. To obtain 5/64 to 3/16 inch gap between the switch and the actuator of the O&K MSD, adjust the _____?
 - a) Switch
 - b) Wheel
 - c) Actuator
 - d) Spring

FIELD PRACTICAL, SKILL TEST

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Perform Preventive Maintenance of the Missing Step Safety Device and demonstrate how to test operate.

- 1. Access a Westinghouse escalator at the LRS to perform PM of the MSD.**
- 2. Access an O&K escalator at the LRS and top landing to perform PM of the MSD**

Inform the Station Agent and Central Control that escalator _____ is back to service.

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Unit 12: Step Out-of-Level & Step Out-of-Position

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Step Out-of-Level & Step Out-of-Position

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform PM for Fujitec, Montgomery, Montgomery KONE, Otis, O&K and Westinghouse as follows;

- Demonstrate how to access step out-of-level and step out-of-position safety devices.
- Clean, inspect and check clearances of step out-of-level and step out-of-position safety devices. Make proper adjustment if necessary.
- Identify defective step out-of-level and step out-of-position safety devices.

D. Clean, Inspect & Test Operate Step Out-of-Level Safety Device

Remove three steps at the LRS.

Move the leading step riser above the LRS **step out-of level safety device** sometimes also called the **step sag safety device** (figure 8-12).

Clean and inspect all mechanism, **lubricate all pivot points** and ensure that they move freely. Wipe off excess oil.

Move the wand towards the combs to actuate the switch (either one switch or two switches, one on each side) through the cam. The unit cannot be started by the starting switch or the remote control until the device is manually reset. Manually reset the cam with the switch roller centered but not touching the cam groove.

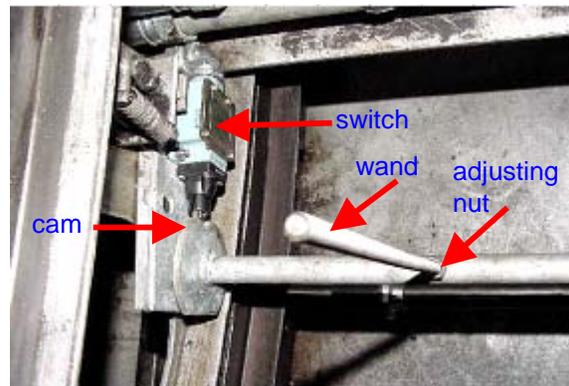


Figure 8-12 Montgomery, Westinghouse & Otis Escalators Step Sag Safety Device

With your body weight on the leading step, the riser above the wand, measure the gap between step riser and the tip of the wand. Insure that the step you are on is in plane and the gaps on both LH and RH side of the step are the same.

Montgomery, Otis and Westinghouse escalators are set at **1/16 inch**. Any step downward displacement of **1/8 in. or more**, the switch will trip.

- If the step is found to be out of plane, inspect the step and chain wheels, shims and/or washers on the step axle for wear and tear.
- If the gaps are found to be different, adjust the wand nuts.

Reset the faultfinder switch after each test.

Perform the same procedures for the step out-of-level safety device at the upper landing.

Reinstall steps and test run the unit.

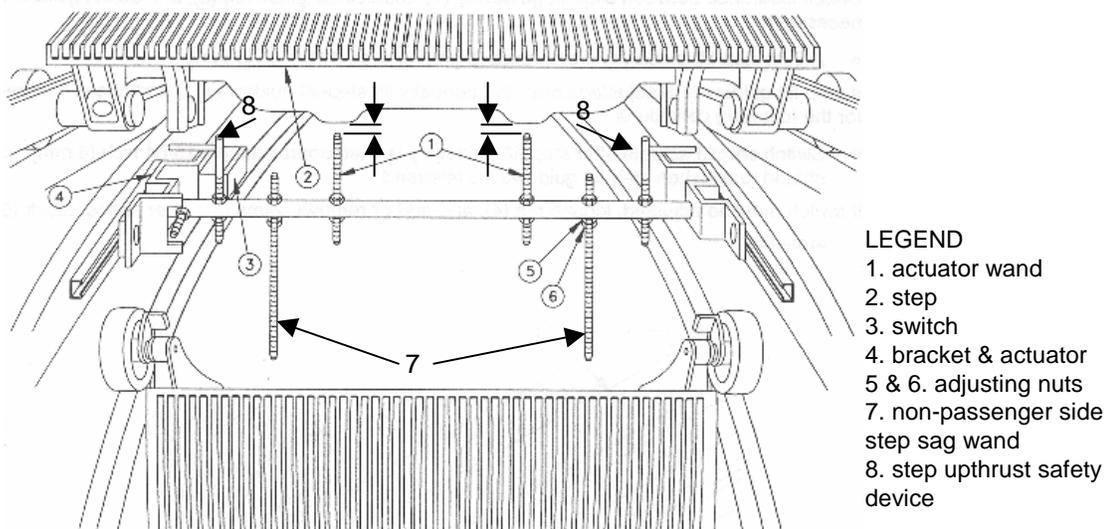


Figure 8-12a O&K Step Sag Monitor & Upthrust Safety

O&K Escalator Step Sag Monitor and Upthrust Safety Device, figure 8-12a.

- Inspect both the step sag monitor and the step upthrust safety devices to actuate the same wand axle, a cam and a switch.
- Any step deviation of **1/8 in. or greater**, the wand will move to turn the cam and the switch actuates. If the switch failed to actuate, correct the problem.

- Inspect the clearance of item 7 above for the non-passenger side steps

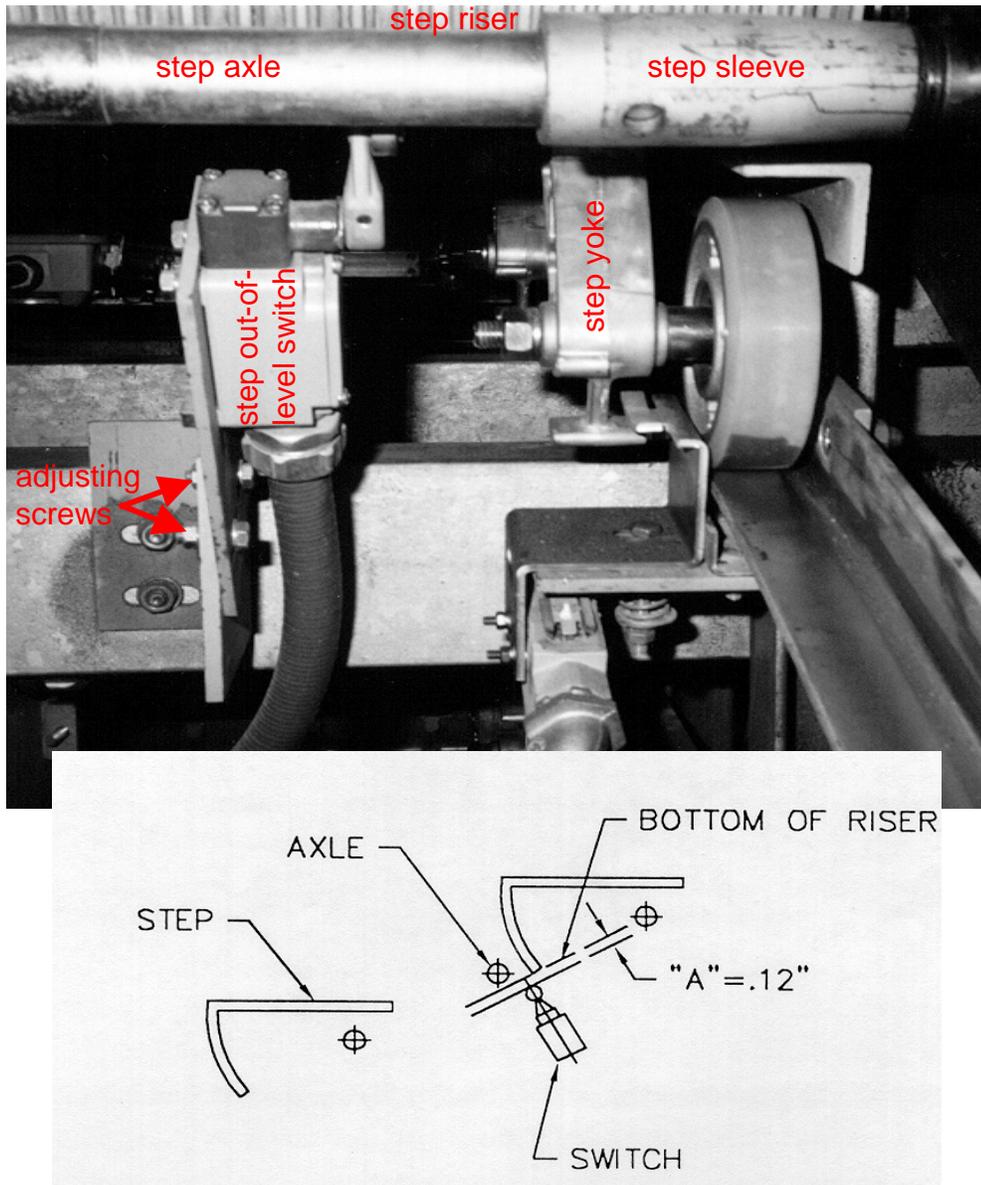


Figure 8-12b Fujitec Upper RH Step Out-of-Level Safety Device

monitor.

Fujitec PS-ST 1200 figure 8-12b. Remove three steps, slide step axle sleeves against the step chains. Move open stepband with the leading step riser above the switch roller. With your weight on the step, set the step sag safety switch assembly bracket to obtain **1/16 in. clearance** between the switch actuator and the riser.

Fujitec PS-S 1200 gap between the riser and the switch is set at **3/32 inch**.

Any step downward displacement of **1/8 in. or more**, the actuator will trip the switch. Reset the fault finder reset switch every time the switch is tripped.

NOTE: When reinstalling Fujitec step sleeve between the step chain axle and the step chain axle seat (step knuckle), align step sleeve to a locking pin and listen for a clicking sound. The sleeve should not turn against the axle.

Perform the below PM for Montgomery KONE out-of-level step detector.

Adjusting procedures

OUT-OF-LEVEL STEP DETECTOR

The *out-of-level step detector* microswitch is designed to be reset in the controller.

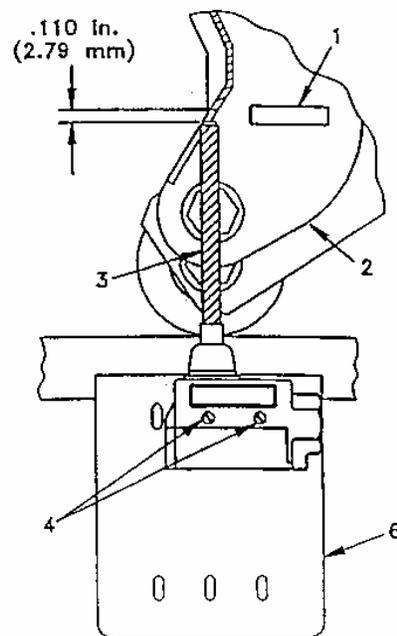
1. Barricade both ends of the escalator.
2. Remove access covers.
3. Remove three steps, and position hole in step band above lower end out-of-level step detector.
4. Turn mainline disconnect OFF.
5. Place a 1/8 inch [3.1 mm] shim (1) between the step side plate (2) and the microswitch wand actuator (3).
 - The microswitch should trip. If it does not, adjust in the following manner.
6. Loosen the microswitch mounting screws (4) connecting the switch (5) to the out-of-level step detector bracket (6).
7. Adjust the switch up or down to achieve a gap of .110 inch [2.79 mm] between the step side plate and the microswitch wand actuator.
 - The switch should actuate when a 1/8 inch [3 mm] shim is placed between the step side plate and microswitch wand actuator. If the switch does not actuate, move the switch upward slightly.

Make sure to reset the switch in the controller after actuation.

8. Turn mainline ON, and position hole in step band above the upper end out-of-level step detector.
9. Turn mainline OFF.
10. Use same procedure to examine and adjust the upper end out-of-level step detector as was used for the lower out-of-level step detector.

Make sure to reset the switch in the controller after actuation.

11. Replace steps and access covers.



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Figure 8-12c

E. Clean, Inspect & Test Operate Step Out-of-Position Safety Device

BART Montgomery KONE is equipped with step out-of-position safety devices (figure 8-12d below); one at the LRS pit and one at the top landing pit.

The step out-of-position wand is too sensitive that it actuate with a light touch. The actuation of the switch requires manual reset of the controller.

The step out-of-position safety device at the bottom pit travels with the LRS as the step chains wears.

Clean and inspect step out-of-position safety device.

The **steps nose lines should be at 1/2 inch from the wand** as the steps goes around its radius.

Perform the same procedures at the top pit out-of-position switch.

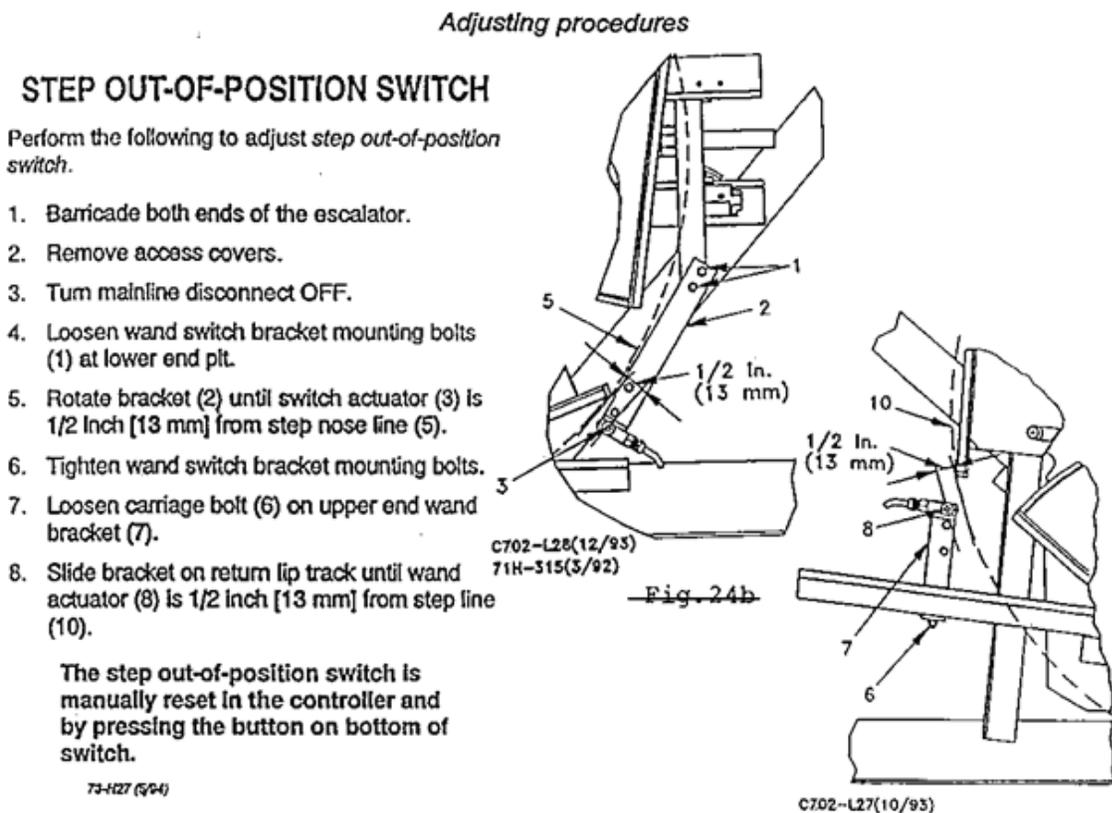


Figure 8-12d Montgomery KONE Step Out-of-Position

Review Questions: Write your name and answer in a separate piece of paper.

1. Which step component of a Westinghouse escalator will actuate the step out-of-level safety device?
 - a) tread
 - b) riser
 - c) axle
 - d) hook

2. How would you reset the step out-of-level when actuated?
 - a) Mechanically
 - b) Electrically
 - c) Manually
 - d) Electronically

3. What is the clearance between the tip of the switch roller of the step out-of-level and the step axle of Fujitec PS-ST 1200 escalator? ____ inch.
 - a) 1/16
 - b) 3/16
 - c) 3/32
 - d) 5/32

4. What other safety device of the O&K escalator is involved with the same switch as the step out-of-level?
 - a) Missing step
 - b) Upthrust safety
 - c) Step out-of-position
 - d) Upthrust safety out-of-opposition

5. Montgomery step out-of-position is adjusted from the step ____ ?
 - a) riser nose line
 - b) axle nose line
 - c) band line
 - d) nose line

FIELD PRACTICAL SKILL TEST,

Perform Preventive Maintenance of the step out-of-level and out-of-position safety devices and demonstrate how to test operate;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

5. Westinghouse

6. O&K

7. Fujitec

8. Montgomery

Inform the Station Agent and Central Control that escalator _____ is back to service.

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Unit 13: Governor Overspeed Safety

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Avoid physical contact with rotating parts.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Governor Overspeed Safety

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform overspeed governor PM for Westinghouse Fujitec, & Otis;

- Demonstrate how to access governor safety devices.
- Clean, inspect and test operate governor safety devices.
- Identify defective governor safety devices.

A. Clean and Inspect Governor Overspeed Safety Device

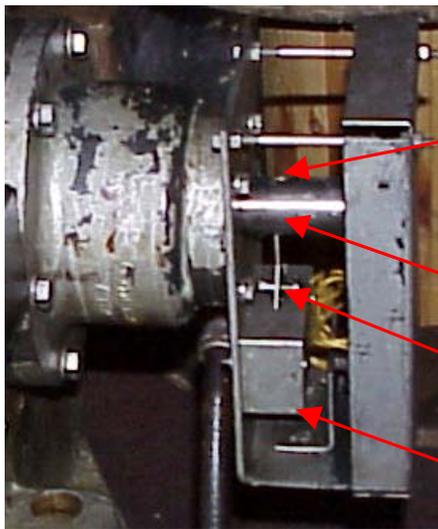
NOTE: Speed Governor Safety device are factory set.

Escalator installed under ASME A17.1-1990 and later editions, verify that the escalator cannot be started by the starting switch until the device is manually reset.

Governor overspeed is not required where the motor is directly connected to the driving machine, CCR Title 8, Elevator Safety.

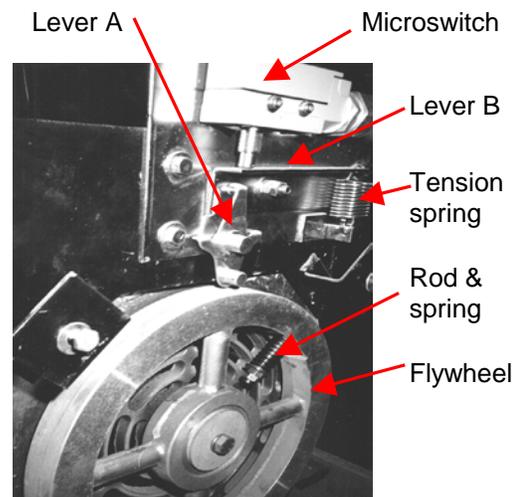
- Remove access cover at the top landing or access motor at a separate room for type “B” escalator.
- Remove governor access cover at the end of the motor housing.
- Clean all mechanism and lubricate pivot points of the governor safety.
- Run the unit in normal operation to test governor safety (figure 8-13 p4) by manually tripping lever “A” (Fujitec) or the switch actuator (Westinghouse) to open the switch. The brake should set and the motor stops.

- The unit will stop and cannot be started until the switch is reset and the fault switch is reset.
- **Manually reset the tripped governor overspeed switch or the reset function/reset switch and return the unit back to service.**
- If the switch did not work, inspect the all mechanisms and the switch.
- Reset lever and reinstall the cover back.



Rod & spring inside hole
Motor shaft
Switch actuator
Switch box

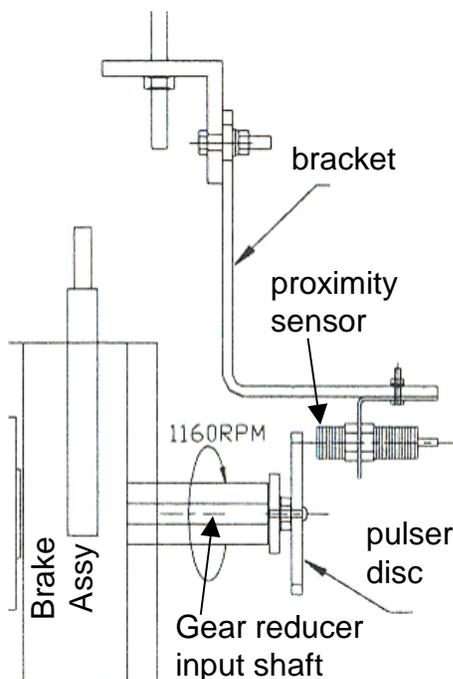
Westinghouse Escalator 38N Machine



Lever A
Microswitch
Lever B
Tension spring
Rod & spring
Flywheel

Fujitec Escalator PS-ST 1200

Figure 8-13 Overspeed Governor Tripping Mechanism



Fujitec PS-S 1200 Governor Pulser Disc.

- Clean proximity sensor and the pulser disc.
- Inspect the bracket and all fasteners of the proximity sensor and disc to be secured.
- The switch has upper and lower set points to stop the escalator at $\pm 20\%$ of the nominal motor speed.

Otis J-Series;

K10/S4 & S5 - Overspeed governor is optional.

K10/S6 & S7, A30/S1 & S2 - Overspeed governor is at the top of the motor. It works similar to Fujitec PS-ST 1200.

REVIEW QUESTIONS. Write your name and answer in a separate piece of paper.

1. The governor overspeed switch of the Westinghouse escalator actuate when an overload exist.
 - a) True
 - b) False

2. Which component maintains the tension of the rod of the Fujitec PS-ST 1200?
 - a) Lever "A"
 - b) Lever "B"
 - c) Spring
 - d) The nut at the bottom of the rod.

3. What will happen if the overspeed governor trips? The brake ____
 - a) opens and the motor stops.
 - b) stops and the motor sets.
 - c) sets and the motor run.
 - d) sets and the motor stop.

FIELD PERFORMANCE, SKILL TEST

Perform Preventive Maintenance of the Governor Safety Device and demonstrate how to test operate;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

- 3. Access a Westinghouse escalator machine room to perform PM of the overspeed governor.**
- 4. Access a Fujitec PS-ST 1200 machine room to perform PM of the overspeed governor.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 14: Reversal Stop Device

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband, the machine and the directional safety device.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Reversal Stop Device

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform PM as follows for Fujitec, Montgomery, Montgomery KONE, Otis, O&K and Westinghouse escalators;

- Demonstrate how to access directional safety devices.
- Clean, inspect and check operation of directional safety devices.

F. Clean, Inspect and Lubricate Reversal Stop Device,

Access and test reversal stop device by turning the start key of a running escalator opposite the direction of travel, the unit must not run in the opposite direction of travel without fully stopping first.

Westinghouse escalator figure 8-14 below);

- **Open reversal stop device cover. Clean the reversal/drag switch contacts, the magnetic strips and the disk. Insure that all switch contacts are opened while the unit is OFF.**
- **Grasp and turn the magnetic plates in one direction to check the contact spring compression. The lever will move opposite the direction of the disc turn, a set of contact closes and the opposite contact should open. The magnetic plate should centers when released. Repeat the same in the other direction.**
- **Insure that when the escalator is**

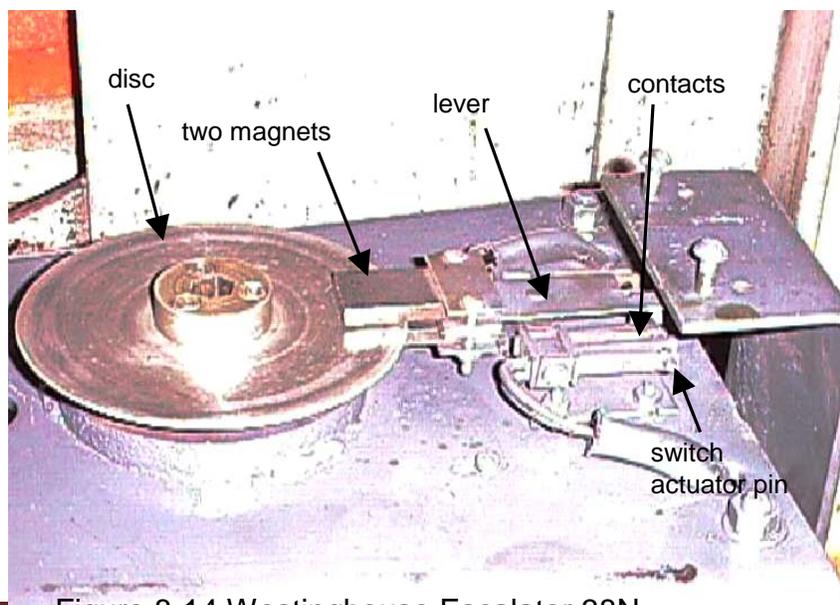


Figure 8-14 Westinghouse Escalator 38N Reversal Stop Device (cover removed)

in normal operation, it closes a set of contacts for that direction of travel and the opposite contacts are opened.

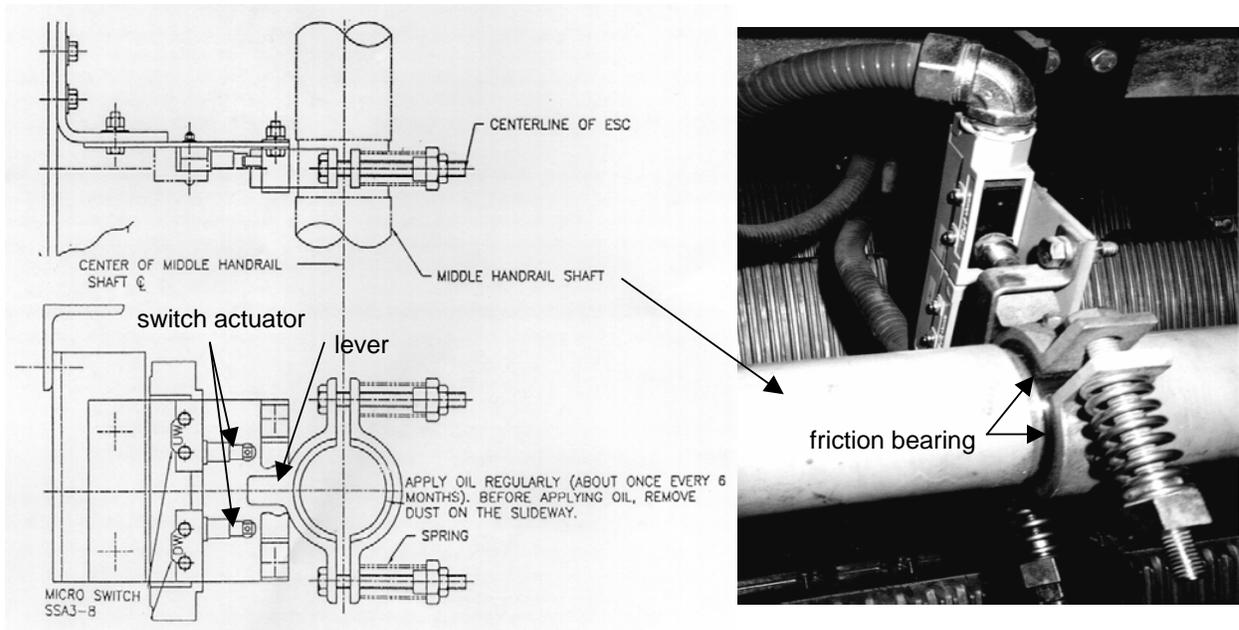


Figure 8-14a Fujitec PS-ST 1200 Reversal Stop Device

Reversal Stop Device or Non-Reversal Device (NRO) by Fujitec PS-ST 1200 is at the upper transition inside the stepband.

- Move missing steps above the NRO of the friction clutch type at the upper incline. Tagout and lockout the unit.
- Clean and lubricate friction bearing of the NRO with a few drops of oil. Insure that the clutch or the lever is in between the two switch actuators.
- Grasp the friction clutch and rotate it in one direction to strike the switch. There should be an audible sound from the switch. Release the clutch, the spring will center the friction clutch.
- Perform the same procedure for the opposite switch. If clutch centering is not achieved, clean spring tension and friction bearing, lubricate bearing and then retest.
- Wedge or tape UW switch plunger to open the switch. Remove tagout and lockout to turn the power ON. Start the unit in the down direction, it will start but stops soon after. Reset and turn the power off.

- Perform the same procedure for the DW switch but this time, run the escalator in the up direction. The escalator will start and stops soon after. If test of switches fails, inspect the spring, the switch and wiring.

Otis Escalator J –Series (figure 8-14b). Clean and inspect reversal stop device of the friction clutch type located at the end of the pinion shaft.

- Lubricate clutch plate and bushing with a few drops of oil.
- Grasp the clutch plate and rotate it in one direction until the lower edge of the switch arm strikes the sides of the slot of the disc. If this condition does not exist, move the switch box until proper centering occurs. Perform the same procedure for the opposite switch.

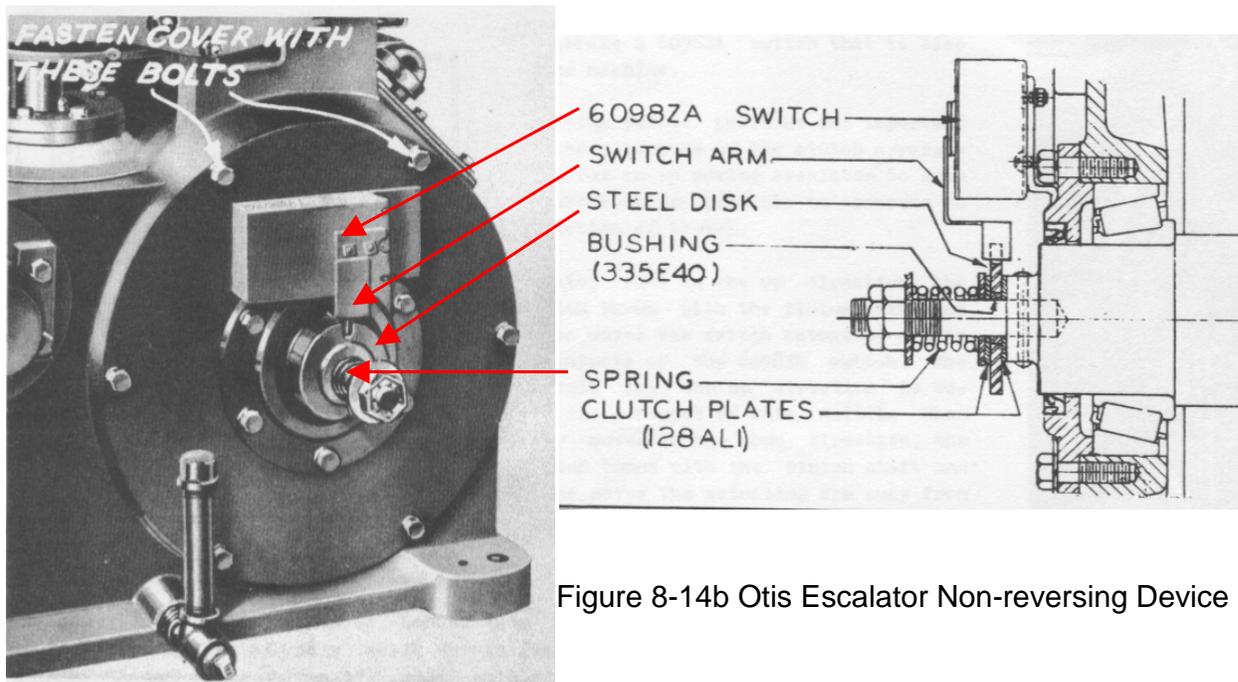


Figure 8-14b Otis Escalator Non-reversing Device

- Run the unit to determine that the disk moves but does not spin with the direction of shaft rotation and just enough for the switch to close in that direction of travel. The opposite switch should open to protect the unit from starting in the opposite direction of travel.
- Perform the same procedure above in the opposite direction of travel.
- Determine that the contacts of the switch have good compression when the actuating arm of the switch is held by the disc.

Montgomery Escalator Reversal Stop Device if equipped, the actuator arm maybe riding above the pinion shaft.

REVIEW QUESTIONS: Write your name and answer in a separate piece of paper.

1. What safety feature does the reversal stop device provides?
 - a) You cannot start the unit without opening the roll up gate.
 - b) Protects the unit from starting in the opposite direction of travel.
 - c) Gives you time delay to start the unit in the opposite travel to protect the motor from burning.
 - d) Protects the unit from starting unless you use remote control.

2. Refer to figure 8-14b page 5, Otis Escalator. Will the steel disk continually spin with the rotor shaft?
 - a) Yes
 - b) No

3. Refer to figure 8-14, Westinghouse escalator. What is the status of the reversal stop switch contacts if the unit is non-operational?
 - a) One set is closed and the opposite set is opened.
 - b) Both sets are closed.
 - c) Both sets are opened.
 - d) Hard to determine since the unit is not running.

Refer to figure 8-14a Fujitec Escalator for questions 4 and 5.

4. With the unit tagout and lockout, what is the status of the friction clutch actuator?
 - a) Turn to the top side of the switch
 - b) Turn to the bottom switch
 - c) Centered between the switches
 - d) Hard to determine since the unit is not running

5. How often should you lubricate the friction brake?
 - a) Twice a month
 - b) Monthly
 - c) Every 3 month
 - d) Every 6 month

FIELD PRACTICAL SKILL TEST,

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Perform Preventive Maintenance by demonstrating how to test operate Reversal Stop Device of the following;

9. Westinghouse

10. Otis

11. Fujitec

Inform the Station Agent and Central Control that escalator _____ is back to service.

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Unit 15: Main Drive Chain & Handrail Drive Chains

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Never take your eyes away from the oiler hose tip while lubricating.

Main Drive & Handrail Drive Chains

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform PM as follows;

- Clean, lubricate, inspect and adjust main drive chain of Fujitec, Otis, and Westinghouse.
- Clean, lubricate, inspect and adjust handrail drive chains of BART escalators.

A. Main Drive Chain; Clean, Lubricate, Inspect & Adjust

Use the remote control where applicable.

Remove six steps at the LRS and move missing steps towards the upper end to access main drive chain located inside the truss for type “A” drive machine.

If main drive chain is located in a separate room for type “B” drive machine, remove chain cover.

Access the main drive chain at the top pit or upper truss. Clean and remove main drive chain cover if equipped and clean debris in the pit or machine room.

Inspect the area underneath the main drive and bull gear sprockets for metallic fillings. If metallic fillings are found, investigate the source. Make the necessary correction.

Inspect the appearance of the chain for corrosion, dirt, stiff bending, and damage on the outside surfaces of the rollers.

Lack of lubrication causes chain stiffness, rust accumulation normally reddish in color, premature wear of sprockets and chains.

If an escalator has an automatic oiler, perform the following;

- **Replenish oil** inside the tank every two weeks for O&K and Fujitec. Avoid leaving an empty tank not to burn the pump motor.
- **Inspect oil filter** inside the oil tank. Replace if dirty. It must be **inspected semi-annually and replace annually**.
- **Check battery** for memory power. Replace every 10 years.
- **Check chains monthly**. Insure they are receiving proper lubrication.
- **Examine automatic oiler tubing** for kinks or leaks.
- **Clean brush tips**. Set brush perpendicular and just barely touching the chain surfaces and not crushed. Replace worn out brush.
- **Examine the oil discharge** onto the chains. If necessary, adjust nozzle or manifold oil flow and timer setting. Excessive oil discharge and misaligned nozzle may cause oil drip onto the pan and the steps which may become safety hazard to passenger.

Fujitec escalator auto oiler squirts oil every 40 hours of operation with 5 minutes drip (1 rpm in a single rise). Manually run the escalator to check the flicker of a green LED during operation of the timer. This indicates that the memory switch is on.

Run the unit in the down travel or where the oil will mostly penetrate between the chain links of the main drive chain during lubrication.

Single strand chain links (figure 8-15).

Lubricate one side of the chain link in two revolutions; once between the inner and outer links, and once between the inner links and the rollers.

Multi strand chain links (figure 8-15, bottom).

Lubricate each strand similar to lubricating single strand and between the middle links.

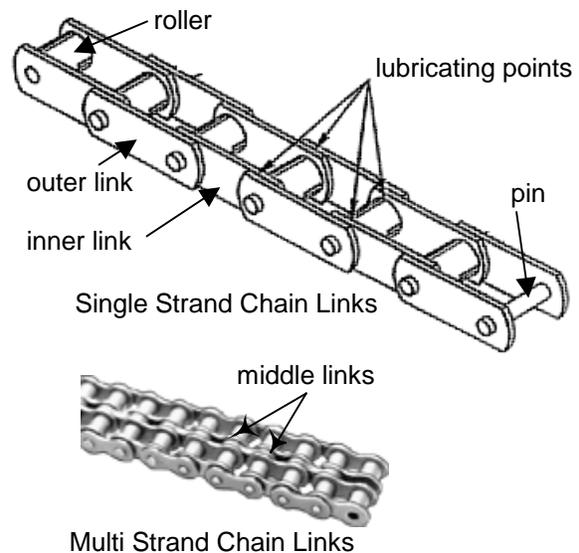


Figure 8-15 Chain Link Lubrication

During lubrication, observe the condition of chain links and rollers, master link cotter keys and clips in place and locked, chain and step wheels condition. Each chain roller should ride in the middle of each sprocket pitch point (figure 8-8c p5).

The wheels of chains and steps shall be not have cuts, breaks, and are fully secured. The chain rollers should be riding squarely between sprockets and not on the sprockets top landing. Replace worn wheels in pair.

If chain rollers ride high on the bull gear sprockets top landing, it is an evidence of chain wear. Report to your Foreworker, the chain needs replacement.

Run the unit for at least twenty minutes for the oil to penetrate.

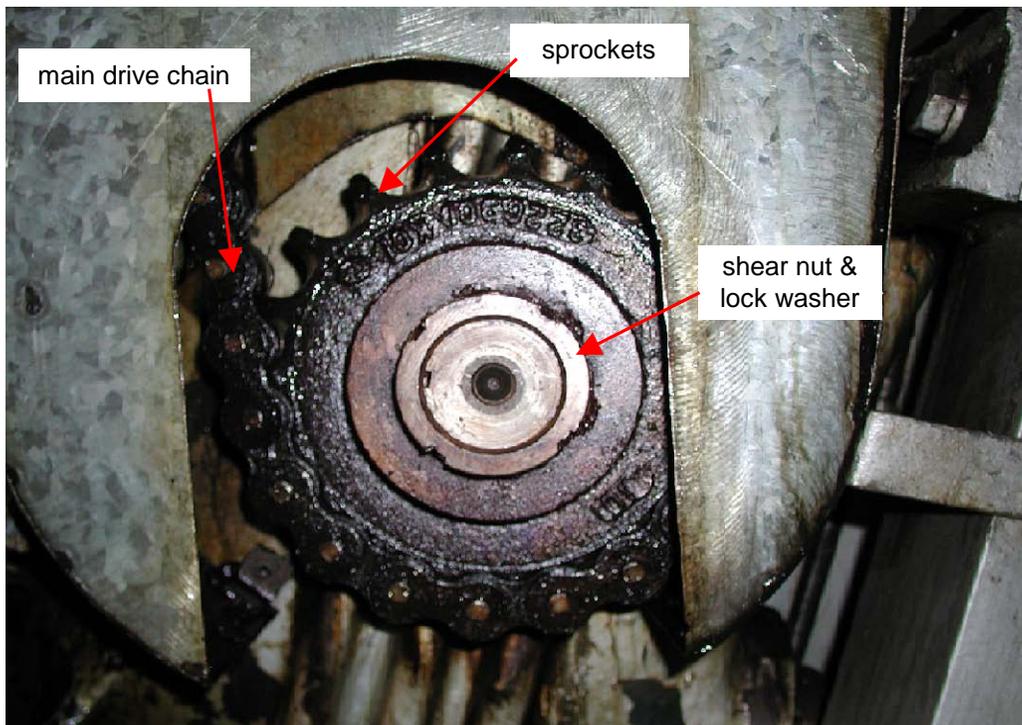


Figure 8-15a. K20/P9 Westinghouse 48N Machine, Vertical Mount
Main Drive Sprocket

Listen and observe the chain for an abnormal noise such as grinding, squealing or clucking, excessive vibration, stiff bending and chain does not seem to straighten out.

If an excessive clucking or clicking noise coming from the bottom of the sprockets (figure 8-15a), it is an indication of an excessive chain slack. Adjust chain tension.

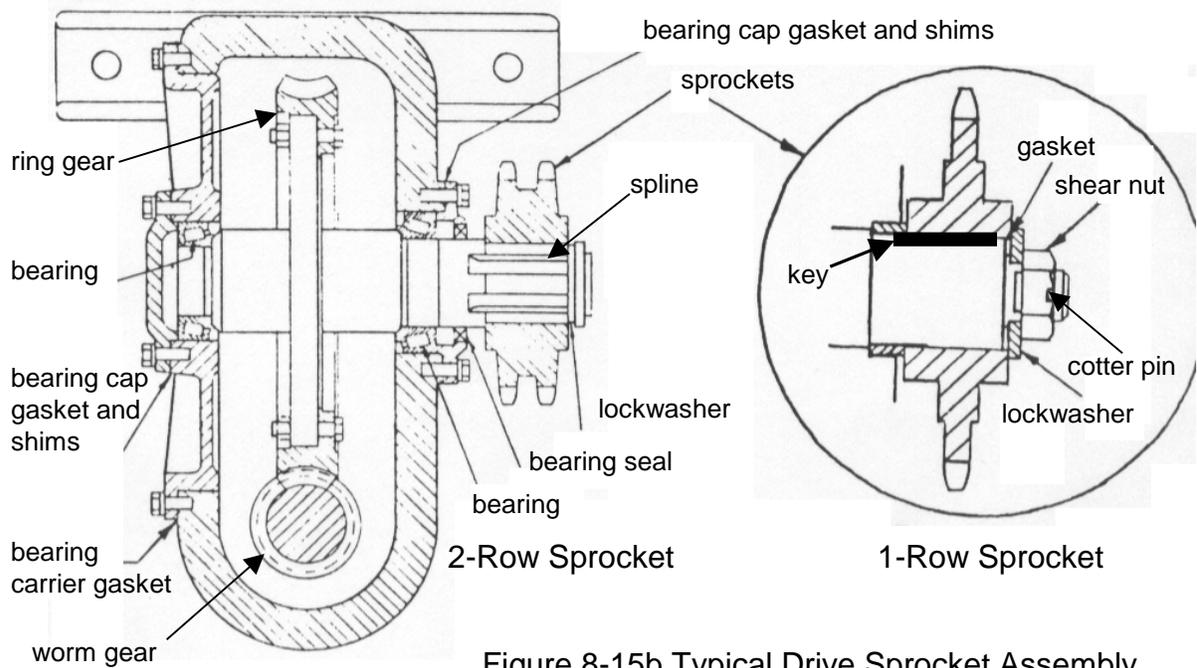


Figure 8-15b Typical Drive Sprocket Assembly

If stiff bending and chain does not straighten out coming from the sprockets, replace chain.

Observe the chain roller and tooth surfaces. Worn chain will normally ride the sprocket top landing.

If chain rides above the sprocket teeth, replace worn chain.

Clean and wipe off any spilled oil or lubricant. Inspect chain wear or cracked on the links and connecting.

Inspect the main drive chain sprocket assembly (figure above) to be firmly secured onto the drive shaft spline. The spline is not worn. The key and cotter pin are in place and locked, the shear nut is tight, and the sprocket does not wobble. If the sprocket wobbles and the shear nut is tight, replace sprocket and or the drive shaft spline.

Inspect the drive chain if they show any evidence of excessive slack around the bottom of the drive sprocket and the main drive of the bull gear sprockets.

If evidence of excessive slack is found, measure the non-taut (figure 8-15c p7) side of the chain opposite the idler after lubrication. Run the unit to bring the chain slack to the non-taut side.

Set the end of the measuring tape rested against the load side and part of the tape extended beyond the anti-load (slack) side.

Move the non-taut chain to measure the slack. Start the measurement from where the chain is setting up to maximum lift.

Calculate the sag of the main drive chain by changing the distance between the sprockets from feet to inches, multiply that number by the % of the span, either 2% for 3ft or greater or 4% for less than 3 ft.

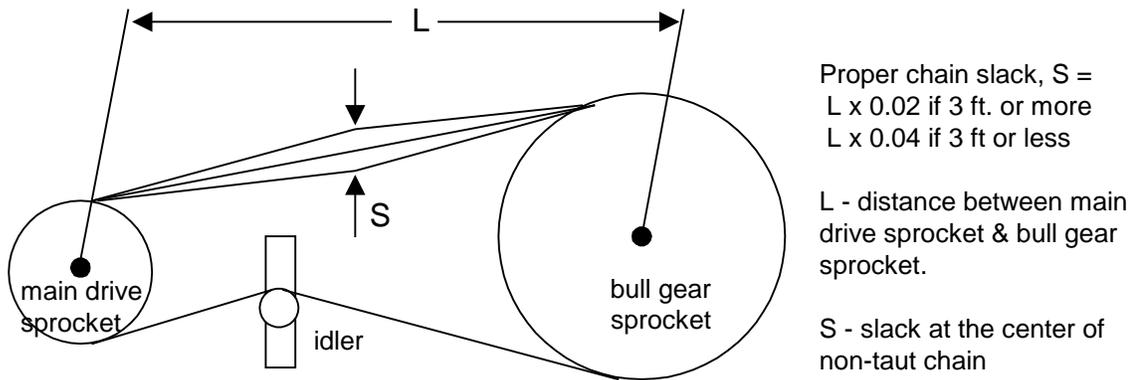


Figure 8-15c Measuring Chain Slack

Otis and Westinghouse escalators are adjusted between **3/8 inch to 1/2 inch**.

Fujitec PS-ST 1200 main drive chain = **5/8 inch – 1 inch**

Run the unit in the reverse direction to bring the slack on the idler side. Adjust and secure the idler after tensioning. Do not over-tension the chain.

Main drive chain adjustment without idler;

- Loosen drive machine mounting and aligning bolts.

CAUTION: Do not disturb the machine alignment against the bull gear.

- Gradually adjust the jacking bolts to take chain slack.
- Check chain slack to be 3/8 inch to 1/2 inch.
- Avoid excessive tension on the chain that may cause vibration and premature chain and bearing wear.

Retighten and torque all bolts. Run the unit to recheck the chain tension.

Fujitec PS-S 1200 (figure 8-15d p8)

Access the top landing to lubricate and to inspect the main driver chain.

Inspect the main drive chain for wear and slack. Jog up the unit then run it down to bring the slack opposite the idler. Measure the non-taut end of the chain. Adjust as necessary.

Inspect the idler sprocket teeth and bearing. Make sure the idler does not wobble. Replace idler if bearing and/or sprocket teeth are worn. Lubricate the bearings. Adjust main drive idler sprocket and secure all fasteners.

Inspect the bull gear, the main drive axle, and the handrail middle shaft pillow blocks. Insure that

- All fasteners are clean, torque and secured.
- Bearings drain plugs are removed and grease replenished. Reinstall drain plugs and clean excess lubricant.
- Shafts are cleaned, checked with level to be in plane and inspected for

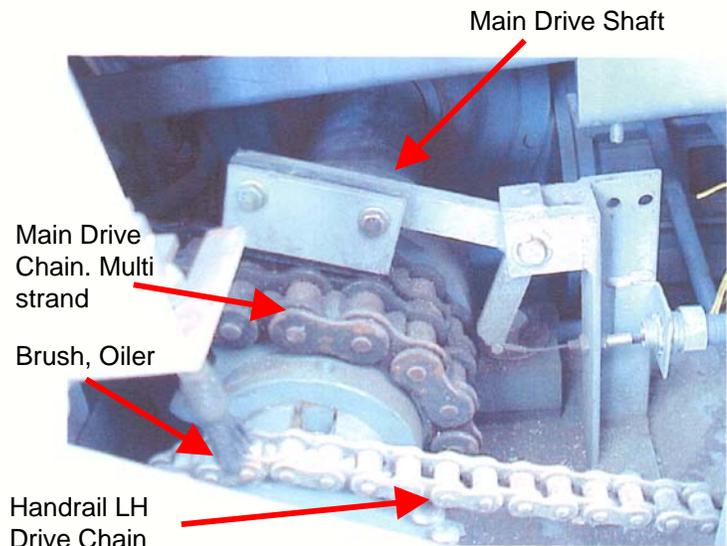
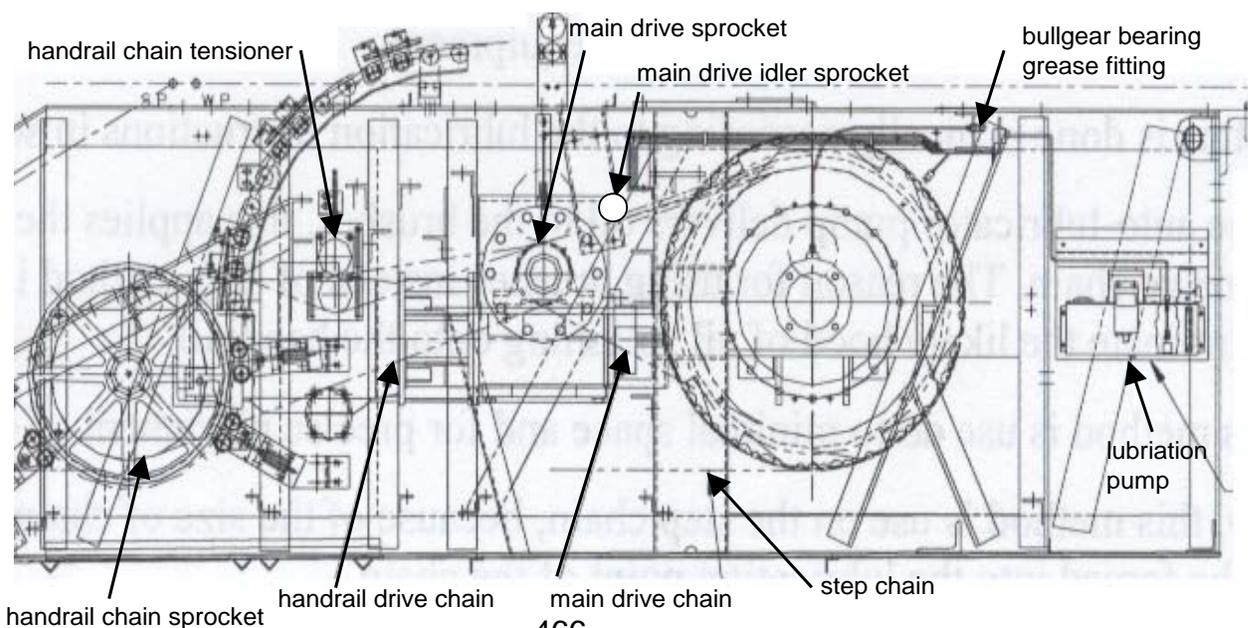


Figure 8-15d Fujitec PS-S 1200 Main Drive Shaft, Main Drive Chain & Handrail Primary Drive Chain



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Figure 8-15e Fujitec PS-S 1200 Main Drive & Handrail Chains

cracked weld.

REVIEW QUESTIONS; Write your name and answer in separate piece of paper.

4. How would you check main drive chain for slack?
 - a) You can check the slack on either side.
 - b) Run the unit to bring the slack on the idler side.
 - c) Run the unit to bring the slack opposite the idler.
 - d) Only when you hear vibrating noise between the chain and the sprockets.

2. Lack of lubrication to the main drive chain causes all of the following, except?
 - a) Rust and corrosion.
 - b) Accumulation of dirt.
 - c) Damage to the chain.
 - d) Stiffness of the chain and wear of the sprockets.

3. Name two probable cause of wobbly main drive chain sprocket.
 - a) Worn spline and loose shear nut.
 - b) Shear spline and worn nut loose.
 - c) Cotter key in place and lock
 - d) Chain wheels are not riding squarely around the sprockets.

4. An acceptable main drive chain slack for Westinghouse escalator is ____ inch?
 - a) $\frac{1}{4}$
 - b) $\frac{1}{2}$
 - c) $\frac{3}{4}$
 - d) $\frac{9}{16}$

5. Where is the main drive chain idler of Fujitec PS-S 1200 located?
 - a) At the top pit.
 - b) Inside a separate room.
 - c) Below the bull gear sprockets.
 - d) Inside the stepband at the top landing.

REVIEW QUESTIONS, SKILL TEST

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Perform Preventive Maintenance of the Main Drive Chain.

- 1. Access Fujitec PS-ST 1200 escalator and demonstrate how to lubricate, inspect, and adjust the main drive chain.**
- 2. Access Westinghouse escalator whose machine room is located in a separate room. Demonstrate how to lubricate, inspect and adjust main drive chain.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 16: Brakes & Broken Main Drive Chain or
Emergency Brake

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Brakes & Broken Main Drive Chain or Emergency Brake

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform PM on Fujitec, Montgomery, Montgomery KONE, Otis, O&K and Westinghouse escalators as follows;

- Demonstrate how to clean, inspect and adjust brakes.
- Clean, inspect and check operation of the emergency brakes.

G. Brakes; Clean, Inspect and Adjust

California Code of Regulations (CCR) Title 8, Article 13.

- There shall be no intentional time delay designed into the brake application.
- The brake shall be applied automatically if the electrical power supply is interrupted.
- The brake shall be capable of stopping the down running escalator with any load up to the brake rated load.
- The escalator brake shall stop the down running escalator at a rate no greater than 3 ft/sec/sec (.091 m/s/s).

A down running escalator with a speed of 90 fpm, it will stop at 4.5 in. from the combs, and at 120 fpm, it will stop at 8 in. from the combs.

- The escalator brake shall provide with a nameplate that indicates the brake torque in ft-lb required to stop and hold brake rated load.
- An electrically released brake shall automatically stop the escalator when any of the safety devices function.

BART escalators standard brake maintenance procedures;

Barricade the unit. Remove 3 steps but no more than 6 consecutive steps if necessary. Move missing stepband above the machine.

Lockout and tagout the circuit breaker.

Install bull gear interlock. Turn motor pit stop switch OFF.

Clean and remove the cover of the motor and machine.

Access and clean the brake assembly. Use compress air to remove dust from covered areas.

Inspect brake pads and drum for wear or oil and abrasive contaminants. If pads are worn or contaminated, replace pads and clean drum. The drum should be clean and smooth. If an indication of scratches is present, inspect the brake pads for wear and replace if necessary. Resurface scratches.

If oil contaminant is coming from the gear box seal, replace seal.

Lubricate all pivot points and add oil to all cups (figure 8-16 p5). Clean any spilled oil.

Turn ON the motor pit stop switch and the power. Energize the brake coil with a remote control or a jumper in the controller to release and to inspect brake wear. With the motor leads disconnected inside the controller, the steps should not move.

Check the air gap between the brake drum and the brake shoe pads. They should have the same gaps all around.

Inspect the brake pads for uneven wear and thickness. **Replace the pads if the lining is 1/3 or less than the original thickness** and if rivets are exposed through the pads. The brake shoe must be securely stable in its mounting. Always replace pads in sets.

After replacement and/or adjustment, check the stopping distance under no load condition from the top landing.

- Run the unit in the down travel and stop to observe the **steps from the upper combs to be no more than 12 inch.**
- If the stopping is more than 12 in., adjust the brake.
- Run the unit in the up travel and observe an immediate smooth stop.

Westinghouse Escalator Brake.

Clean areas near pivot points. Lubricate all pivot points. Refill oil well through oil caps (figure 8-16 p5). Avoid oil spill around the brake drum and brake

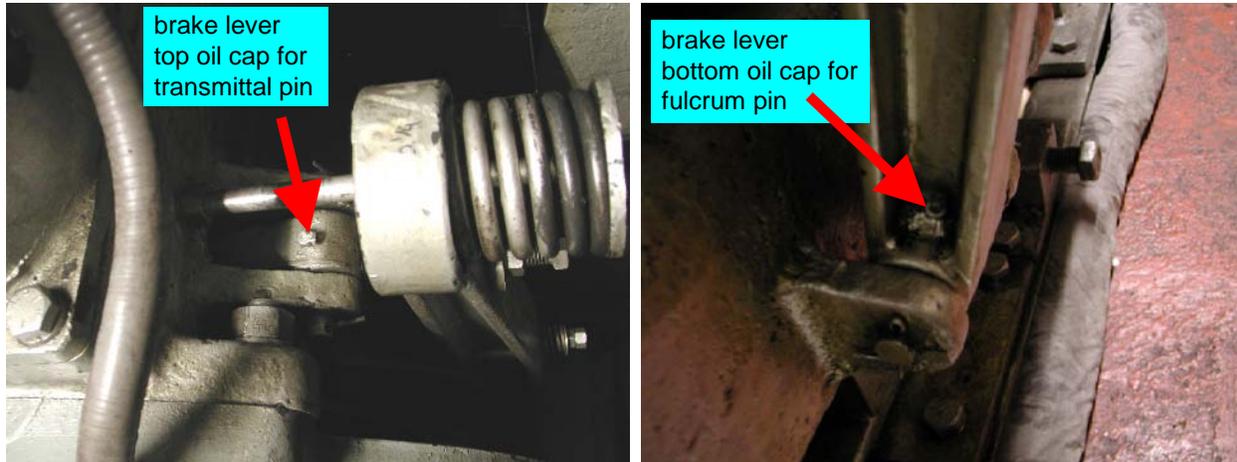


Figure 8-16 Westinghouse Escalator Brake Assembly Oil Cap

shoes. Wipe off excess lubricant.

Access and mark the location of the brake plunger in reference to the upper lip of the brake coil housing (figure 8-16a p6).

Temporarily turn the circuit breaker to turn the brake contactor ON inside the controller by using a jumper to energize the brake coil and to release the brake. The plunger should pick without delay, the brake switch closes, and the brake shoes are clear off the drum.

Check the brake plunger to pull inside the housing to 3/16 in., just enough to clear brake shoes off the drum. The brake switch should be closed.

If brake plunger traveled more than 3/16 in., turn the power OFF to adjust.

Loosen both brake adjusting nuts (12) and studs (13) until plunger sets on its bottom. Mark the location of the plunger against the upper lip of the coil housing and/or measure the depth inside the housing if the plunger pulls below the lip.

Gradually tighten one brake adjusting stud (13) to raise the plunger to 3/16 inch. Firmly hold the stud to tighten the nut without disturbing the adjustment.

Gradually tighten the other stud at the opposite side until you see the plunger moves but not to raise it. Tighten the lock nut and maintain armature plunger setting from **1/8 in. to no more than 3/16 inch**. When the brake is energized, the roller on the brake switch should clear the plunger by **1/64 inch**.

Turn the power OFF, remove brake contactor jumper and reinstall the motor leads.

Run the escalator to check the stopping distance of the steps at no load in the down travel to be 8 in. maximum at 120 fpm escalator speed.

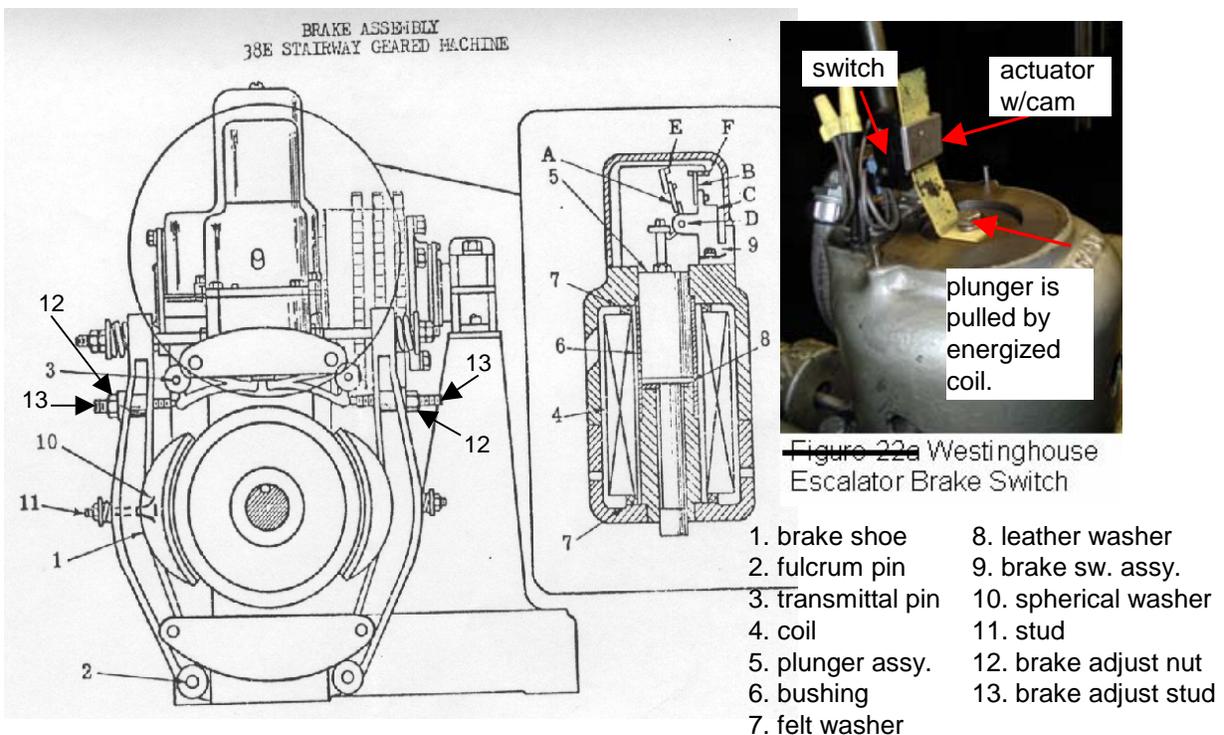


Figure 8-16a Westinghouse Escalator Brake Assembly 38E

Montgomery & Montgomery KONE Brakes (figure 8-16b p7).

Remove six steps and move missing stepband above the machine. Install bull gear interlock. Turn off motor pit stop switch.

Turn controller NORM/OFF/CONST switch in CONST position for Montgomery KONE. Install jumper for the broken handrail speed sensor. Disconnect motor leads for Montgomery.

Disengage the brake by using the Remote Control. Clean brake surfaces.

Check the clearance between the discs brake magnet (14) and the armature (9). There must be an even air gap all around.

Visually inspect the condition of the brake pads and linings, discs and hardware. Check the wear pattern and thickness of the friction brake.

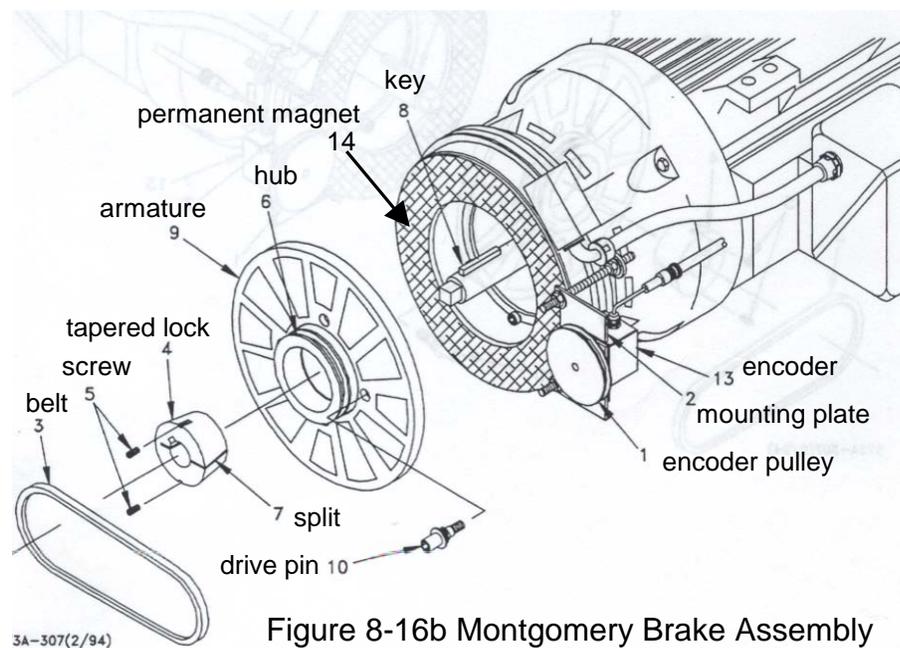


Figure 8-16b Montgomery Brake Assembly

Replaced the brake if the magnet of the friction material shows signs of wear and exposed base material.

Inspect all hardware to be in good condition and are secured, the pressure and retainer springs behind drive pins are tensioned.

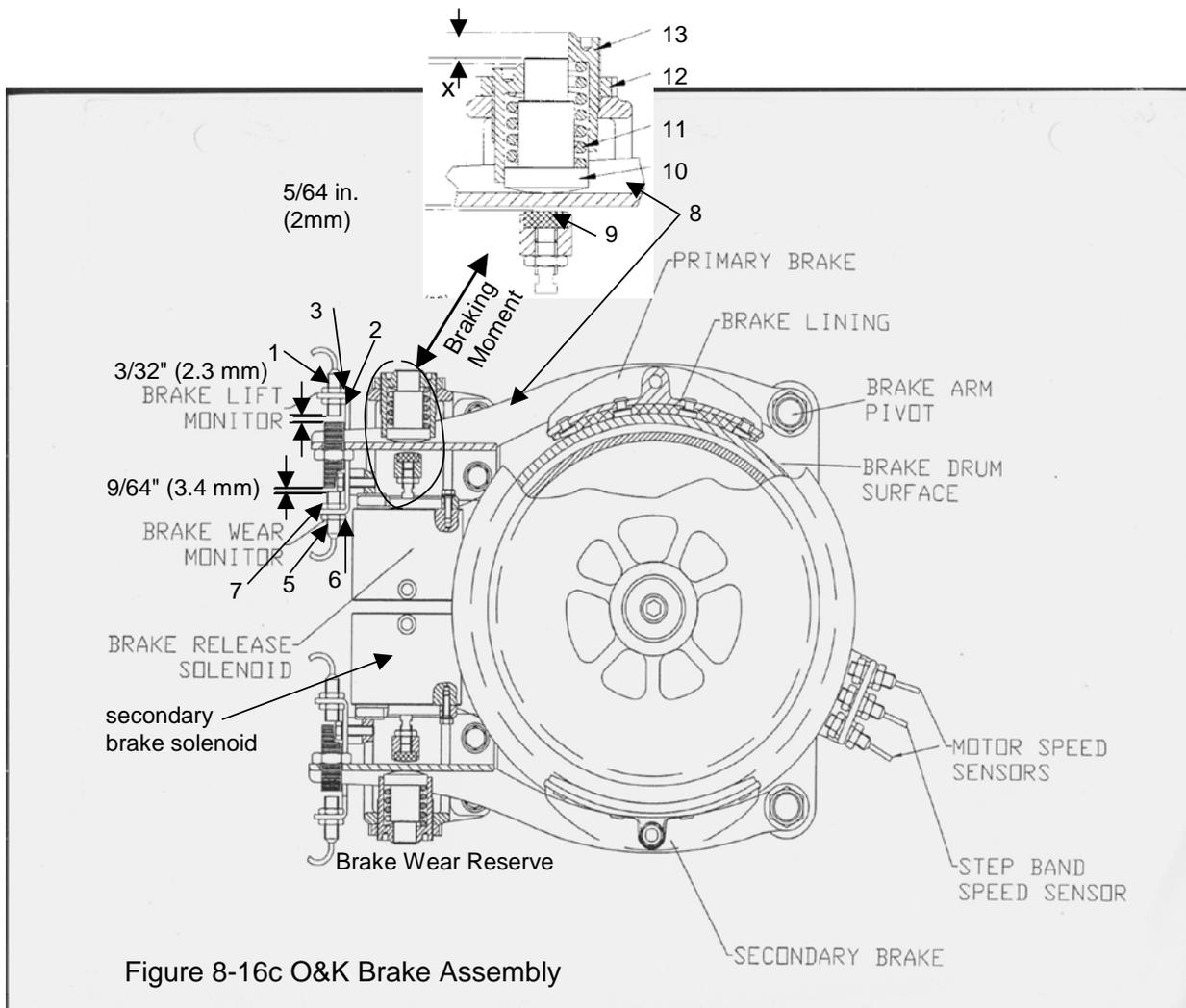
Remove the bull gear interlock, reconnect motor leads in the controller, remove jumper from the broken handrail speed sensor, turn switch to NORM and test run. The unit shall stop smoothly in both directions. The brakes will have a burnishing sound after starting.

O&K Brake Monitor (**figure 8-16c p8**).

Remove five steps and move missing step above the machine. Set Brake Wear Reserve parameters to be of the same as the Primary Brake. Check for the following;

Adjust Brake Release (lift) Monitor **gap** between the sensor (1) and the pin to 3/32 in. (2.3mm) when the brake is applied. To adjust, loosen and adjust sensor nuts 2 & 3. After securing the sensor, recheck the gap.

Adjust Brake Wear Monitor **gap** for brake lining wear to 9/64 in. (3.4mm). The minimum brake lining thickness is 1/8 in. (3mm).



O&K Braking Moment gap is 5/64 in. (2mm) for minimum breaking distance. To reduce the braking moment, loosen groove nut (12) and adjusting ring (13). If dimension X reaches 5/8 in. (15.5mm), the compression spring is completely relieved and the braking moment is equal to zero. The greater dimension X is, the greater the breaking distance is, and the smaller the braking moment.

Fujitec Escalator Brakes. Model PS-ST 1200 (figure 8-16d p9)

Adjust air gap adjuster nut (2a) as set to **5/64 in. minimum**.

Check clearance between drum and shoe pads to be the same all around. Adjust shoe equalizing bolt to maintain equal clearance between each shoe and the

Air gap between the tip of measuring plate and back of brake shoe; Min. = 5/64 in., Max. Stroke = 1/8 in.

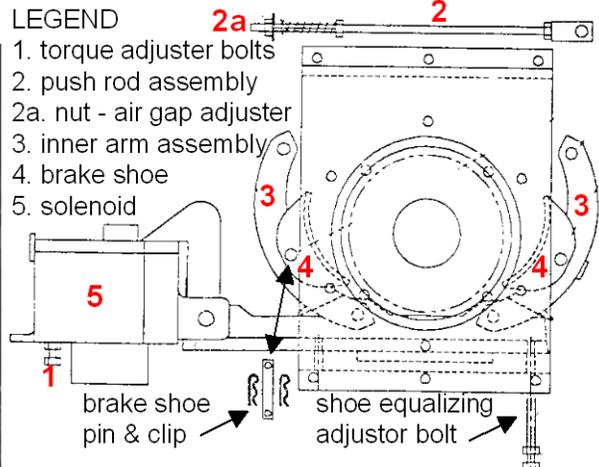
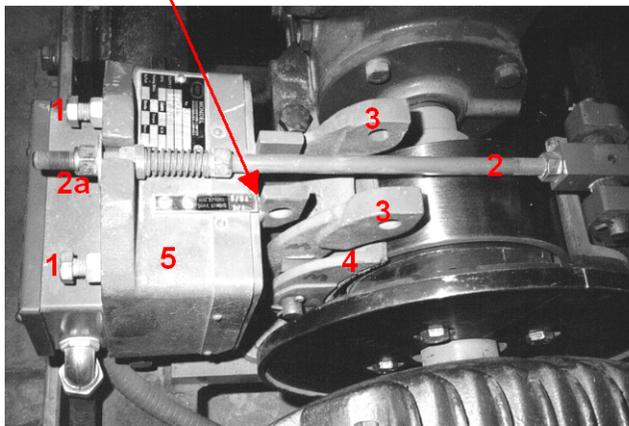


Figure 8-16d Fujitec Escalator PS-ST 1200 Brake Shoe Assembly

drum.

Fujitec Model PS-S 1200

Remove six steps. Move missing step above the machine to;

Check the condition of wiring sensor and friction plate.

Adjust air gap to **.3mm (0.012 in)**. When the gap reaches .6mm, the air gap should be adjusted. Slacken the socket head cap screws to release the threaded spacers which can be adjusted in and out to change the axial position of the armature and the mounting plate. Set the axial air gap to .25 mm~.35mm

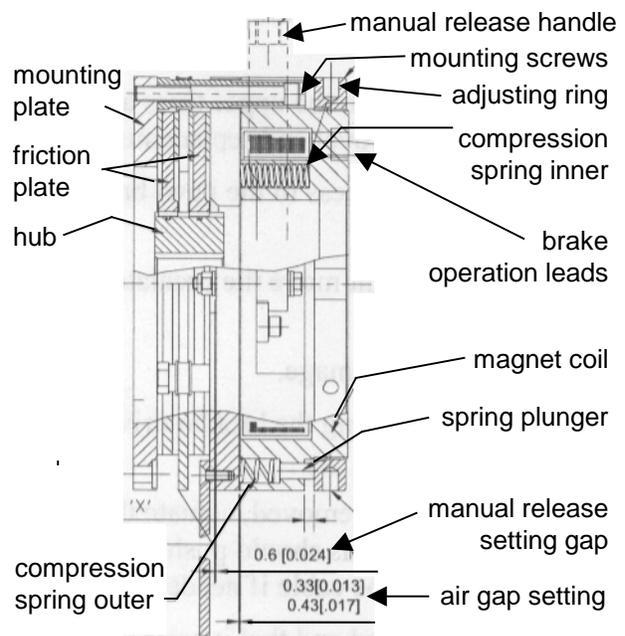


Figure 8-16e Fujitec Model PS-S 1200

Check brake wear lining detector; when the brake lining is 100% deteriorated, the plate will trip the limit switch and cut power to the motor. When this occurs the discs have to be replaced.

Check the stopping distance under no-load conditions to be **8-12 inches** from the end of the comb.

Check the brake torque. Required torque is specified on the label plate attached the brake cover.

H. Broken Main Drive Chain or Emergency (Pawl) Brake; Clean and Inspect

Insure that the main drive chain lubricated and tensioned, all pivot points are cleaned and lubricated, replace brake shoe if less than 1/3 of its original thickness.

Remove the brake shoe to insure pawl brake engages and the switch opens. Verify that the drive motor circuit opens and the escalator cannot be started by the starting switch until the device is manually reset. Reset the pawl brake system and the control panel.

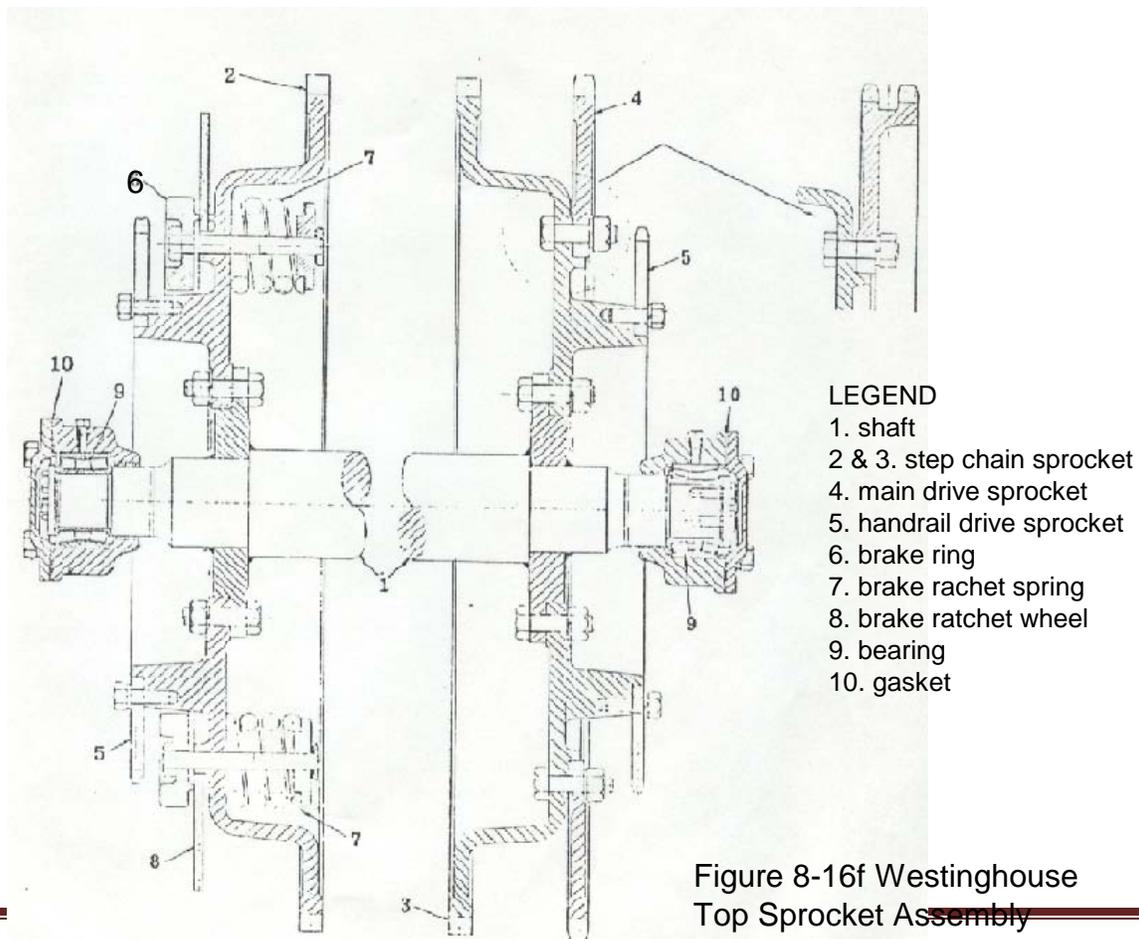


Figure 8-16f Westinghouse
Top Sprocket Assembly

Clean and inspect brake ratchet (ring) hardware around the bull gear. Insure that all fasteners and springs are securely fastened and torque and the pawl is aligned with the ratchet.

Westinghouse Emergency Brake or Pawl Brake (figures 8-16f p10 & 8-16g below).

Remove four steps and move missing steps around the bull gear to access the emergency brake.

Check the clearance between the pawl (C) and the outer edge of the ratchet to be **5/8 inch**.

Check the switch roller tripping distance to be **1/2 inch** riding on top of the cam. Adjust the switch if necessary.

Dismount the shoe (F) from the control arm (D). The control arm shaft rotates, pawl engages against the ratchet and the cam opens the switch.

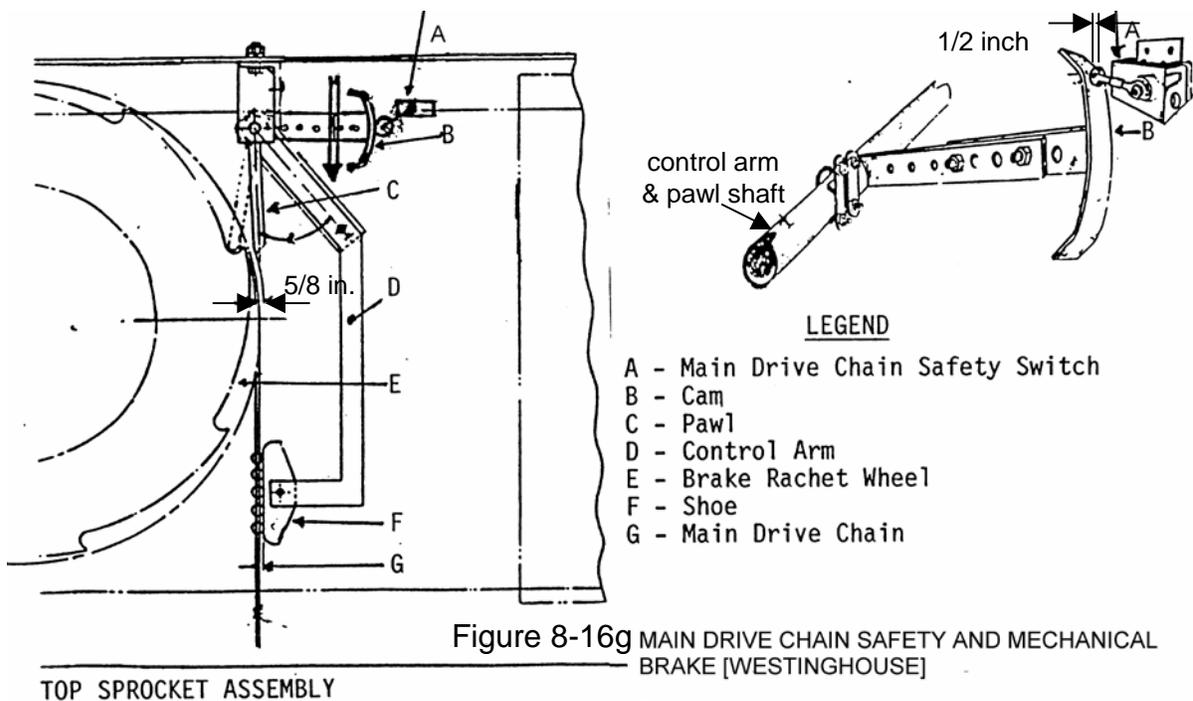


Fig-20

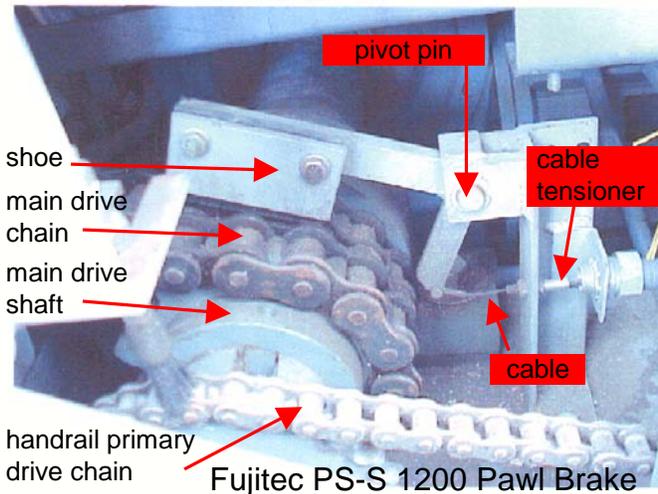
Use the remote control to verify that the unit will not run in down travel if the pawl is engaged and the switch opened.

Fujitec Escalator Model PS-S 1200
(picture at right & figure 8-16h)

Remove four steps leave one then remove four more steps to access the pawl brake at the upper transition.

Inspect the cable and its housing for tension and wear.

Inspect all hardware and ratchet springs to be secured.



Verify that the pawl is fully engaged and the switch opens. Remove guide shoe mounting bolts to push the cable in. The lock lever disengages the brake pawl assembly, the pawl should engage the ratchet, and the switch should open. The LED #5 on the newel skirt fault panel should illuminate. Adjust if needed.

25 mm (0.98 in.) = minimum distance before pawl triggers.

100 mm (3.94 in.) = minimum distance required for locking pawl into position.

Reset the control panel before the escalator can be restarted.

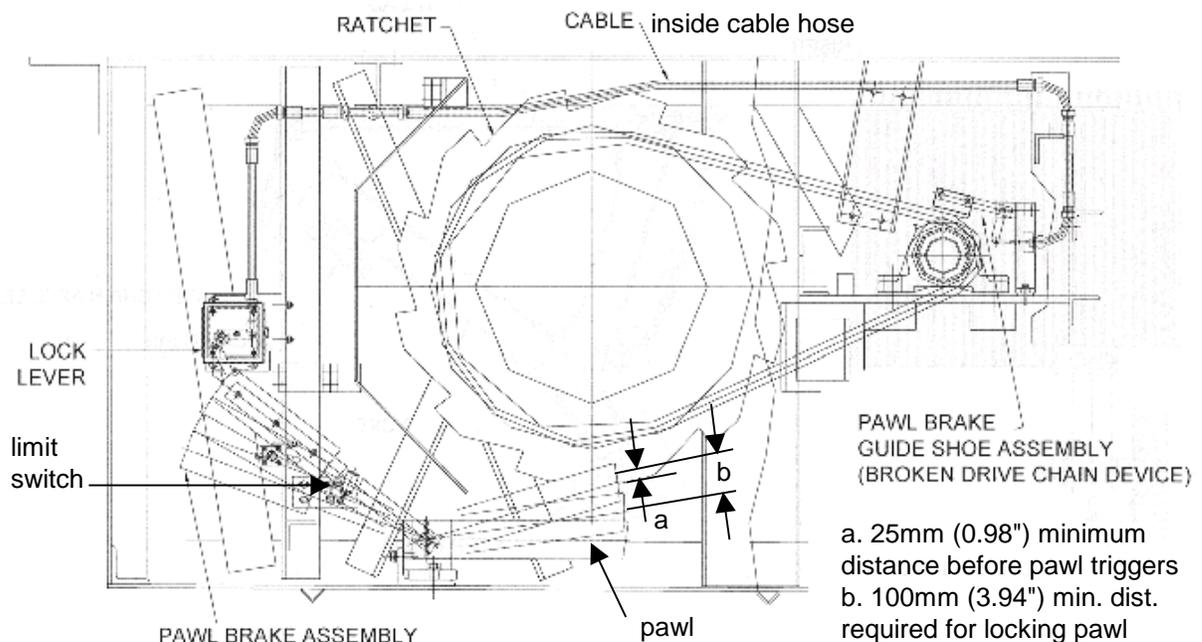


Figure 8-16h Fujitec Model PS-S 1200 Pawl Brake

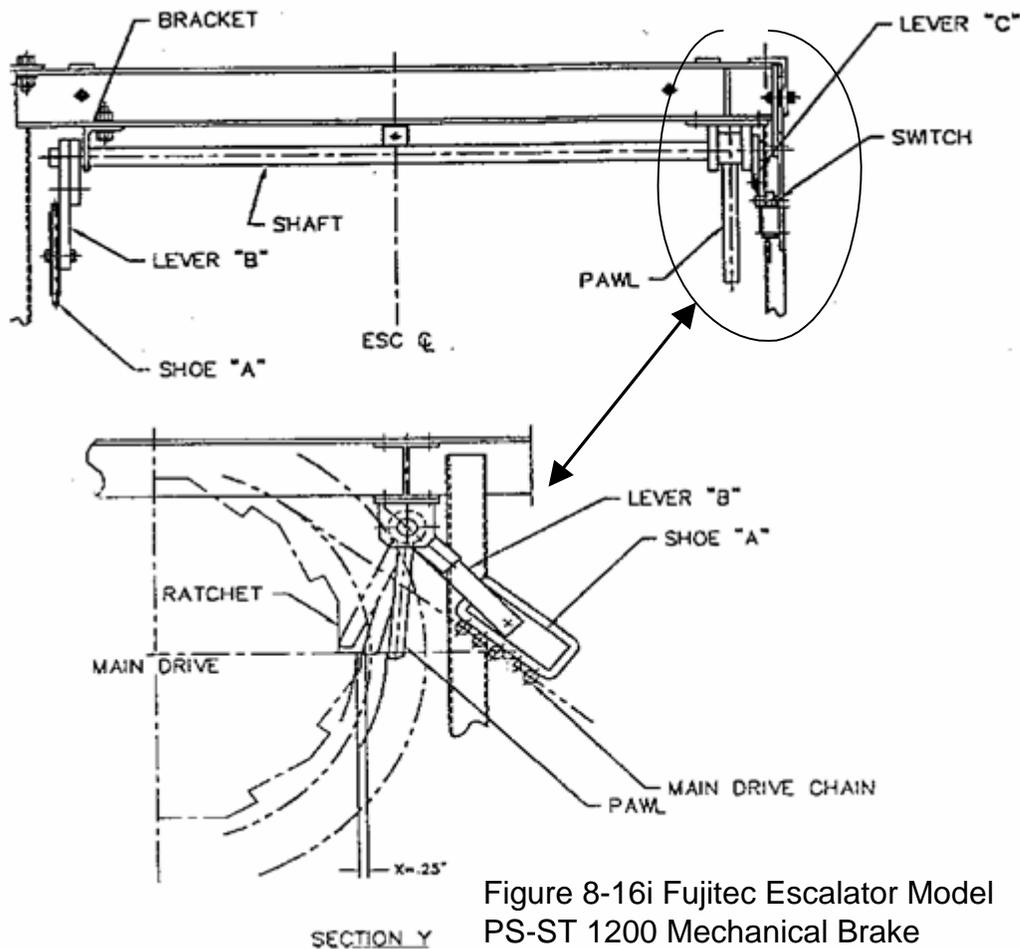
Fujitec Escalator Model PS-ST 1200 (figure 8-16i).

Set Fujitec pawl to **0.25 in.** from the ratchet (figure 43 p101 of the O&MM p6-4 & figure 6-6). Remove shoe (A) to set the distance of the pawl against the ratchet and to open the switch. Run the unit in the down travel, the escalator must not run. If the switch did not open, the motor will try to run.

Push lever "B" against the main drive chain and measure the distance between the pawl and the ratchet to be **0.25 inch.**

Twist the shaft to engage the ratchet. Move the unit with a remote control in the down travel. The motor should either stall or rotate very slowly if emergency brake functioned properly. Do not prolong holding on the remote control switch to avoid tripping of the motor overload.

If the ratchet does not engage after turning the shaft, adjust the position of the pawl brake shaft support bracket.



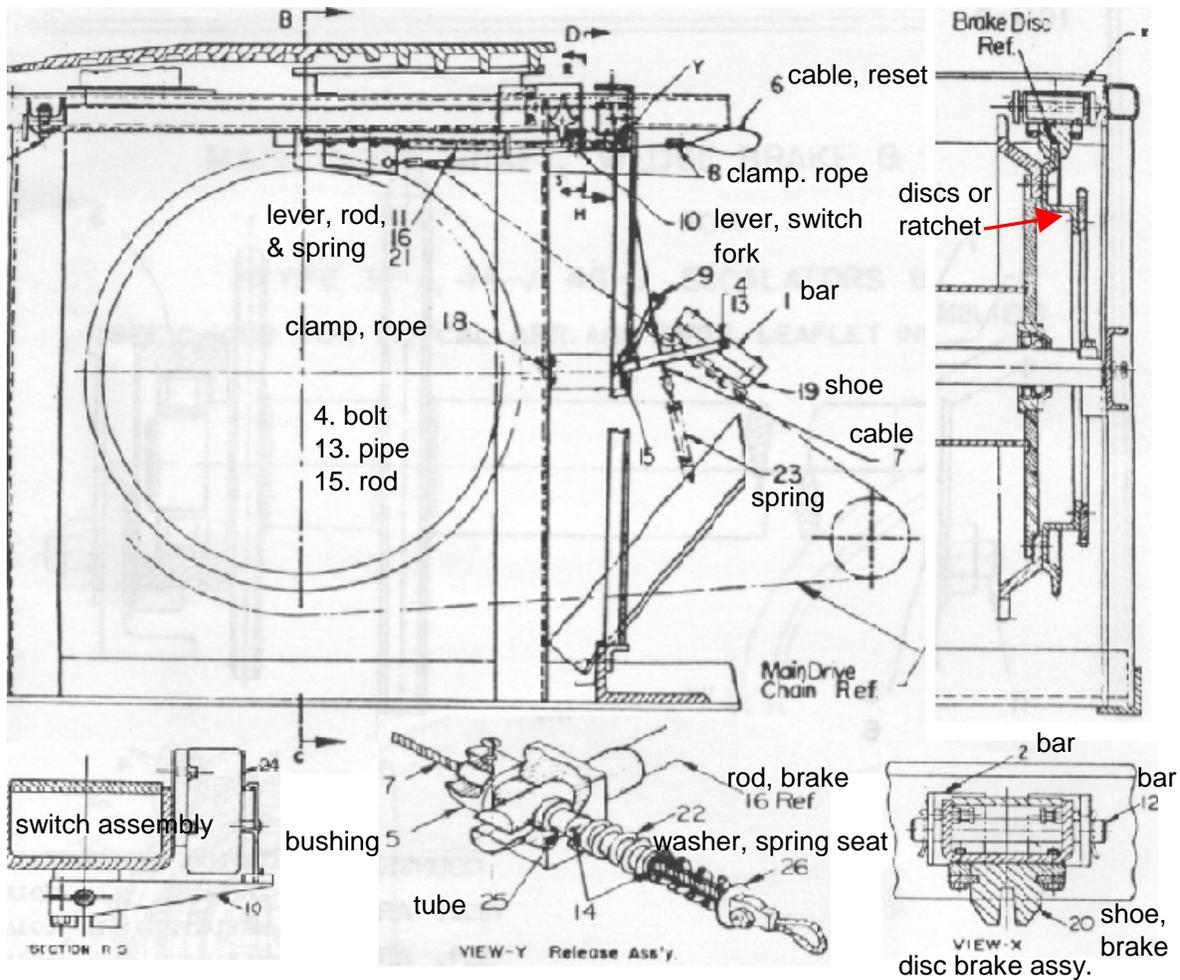


Figure 8-16j Otis Type J Escalator Wedge Brake (Emergency)

Otis Type J Escalator Wedge Brake figure 8-16j

Inspect wear of shoe (19) and discs brake shoe (20). Check the cable and its housing for damage. **Replaced shoe if less than 1/3 of original thickness.**

With the main drive chain properly tensioned, inspect and operate the release assembly (Y) by removing the bolt that holds the shoe bar.

Observe the brake rod (16) to unlatch the release assembly, the switch lever opens the switch, and the disc brake wedge clamps against the discs.

Run the unit with a remote control in the down travel. The motor must not start with the switch opened and the discs brake engaged.

Reinstall the shoe and reset the release assembly. Insure that the brake rod (16) securely latches in front of the tube (25). The brake shoe (20) is clear of the discs and the switch and switch lever are reset. Insure that the release assembly is engaged properly and all hardware are secured.

REVIEW QUESTIONS. Write your name and answer in a separate piece of paper.

1. Westinghouse escalator brake plunger is set at _____ inch?
 - a) 1/16
 - b) ¼
 - c) 3/8
 - d) 3/16

2. What is the maximum step travel from the combs of a 120 fpm escalator speed? ____ inch
 - a) 4.5
 - b) 8
 - c) 8
 - d) 12

3. What is the clearance between the pawl and the ratchet of Fujitec PS-ST 1200 mechanical brake? ____ inch
 - a) 1.0
 - b) 0.75
 - c) 0.5
 - d) 0.25

4. How would you access a Fujitec PS-S 1200 main drive chain?
 - a) Open the top pit.
 - b) Remove 3 steps and move open step band at the upper incline.
 - c) Remove 3 steps and move open step band at mid section of the unit
 - d) Go to a different room below the top pit.

5. Where is the secondary brake of O&K escalator located?

6. What is the clearance of the brake lift monitor of O&K escalator?

7. The emergency brake of Westinghouse escalator engages due to ____?
 - a) Broken step chain.
 - b) Loose or broken main drive chain.
 - c) Broken or loose handrail drive chain
 - d) Wrong setting of plunger brake.

REVIEW QUESTIONS, SKILL TEST, Perform Preventive Maintenance of the;

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Perform Preventive Maintenance of the brakes and broken main drive chain or emergency brake;

- 5. Westinghouse escalator brake.**
- 6. Fujitec PS-ST 1200 escalator brake.**
- 7. Fujitec PS-S 1200 escalator emergency brake.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

Unit 17: Novatex Boards for Montgomery & Montgomery KONE

CAUTION:

Tagout and lockout circuit breaker whenever you access the stepband.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Novatex Boards (Novatex Chain Support Boards)

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to perform PM for Montgomery KONE and Montgomery as follows;

- Demonstrate how to access and to maintain Novatex Boards.

A. Novatex Boards; Clean, Inspect and Adjust

- Clean, inspect and check step roller clearances from the Novatex Chain Support Boards. Adjust if necessary
- Lubricate and adjust the step chain springs prior to novatex board adjustment.
- Remove 5 steps to access novatex boards (figure 8-17 p4 Upper End Tracks and Novatex Boards, Montgomery KONE O&MM pC-14).
- Always pushed back and secure LH and RH chain wheels against the chains after removing steps.
- Access at the top landing with remote control to move missing steps seats above the apex of the novatex boards.
- Montgomery KONE, remove 5 steps and then run the escalator down past 13 steps. Remove 3 more steps to access the lower novatex boards.
- Follow adjusting procedures in figures 8-17 p4, 8-17a p5, and 8-17b p6. Check the novatex board to a height that the steps wheels entering and exiting not to bump against the ends of the boards.
- Insure that the center portion supporting the step will allow turning of the flanged step wheels while the adjuster has his or her weight on the step.
- Insure that the novatex board must support the chain roller at the apex of the board curve (figure 8-17b p6, Proper Setting of Novatex Board under the Chain Roller, O&MM pC-16).
- Clean and check lower novatex boards (figure 8-17c, O&MM page C-17) and perform similar PM as the upper novatex board (the drawing is upside down where the step treads should face the drip pan). Inspect all novatex board fasteners to be secured.

Checking novatex boards

With steps removed to allow access to novatex boards, check the relationship between step rollers, chain rollers, and novatex boards as follows.

1. Move the opening in the step band until five step rollers are located above the upper novatex board (1) in the following manner.
 - Two step rollers (4) will be approximately centered on novatex board.
 - The step opening should be positioned so that installed step assemblies (3) are attached to both step rollers (4) in the middle of the board.
2. Turn the mainline disconnect OFF.

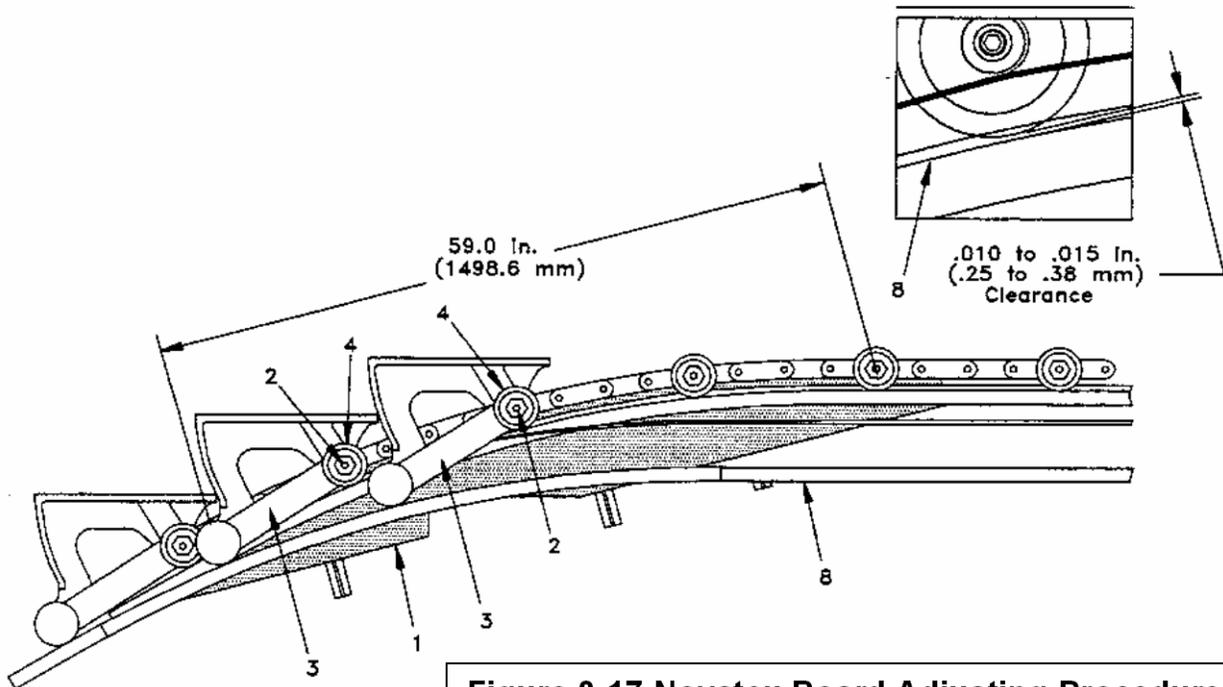
After step band opening is positioned with steps (3) attached to middle step rollers (4) over novatex board, the chain and step rollers are in their correct position, with their full load on the novatex board.

3. Place your body weight on both steps (3), and check the following.
 - Step rollers (4) should turn freely.
 - Chain rollers (5) which are in line with free-turning step rollers (4) should NOT turn, because they should be bearing down on the apex of the novatex board.
 - Chain rollers (6) (7) on either side of chain rollers (5) also bear on the novatex board.

When checking novatex boards, remove any oil on step rollers or tracks. Oil on step rollers or tracks may allow step rollers to rotate, giving a false indication that step rollers do not have any pressure or load on them.

4. Re-position step band, if necessary, to check lower novatex board, and check lower novatex board in the same manner as the upper novatex board.

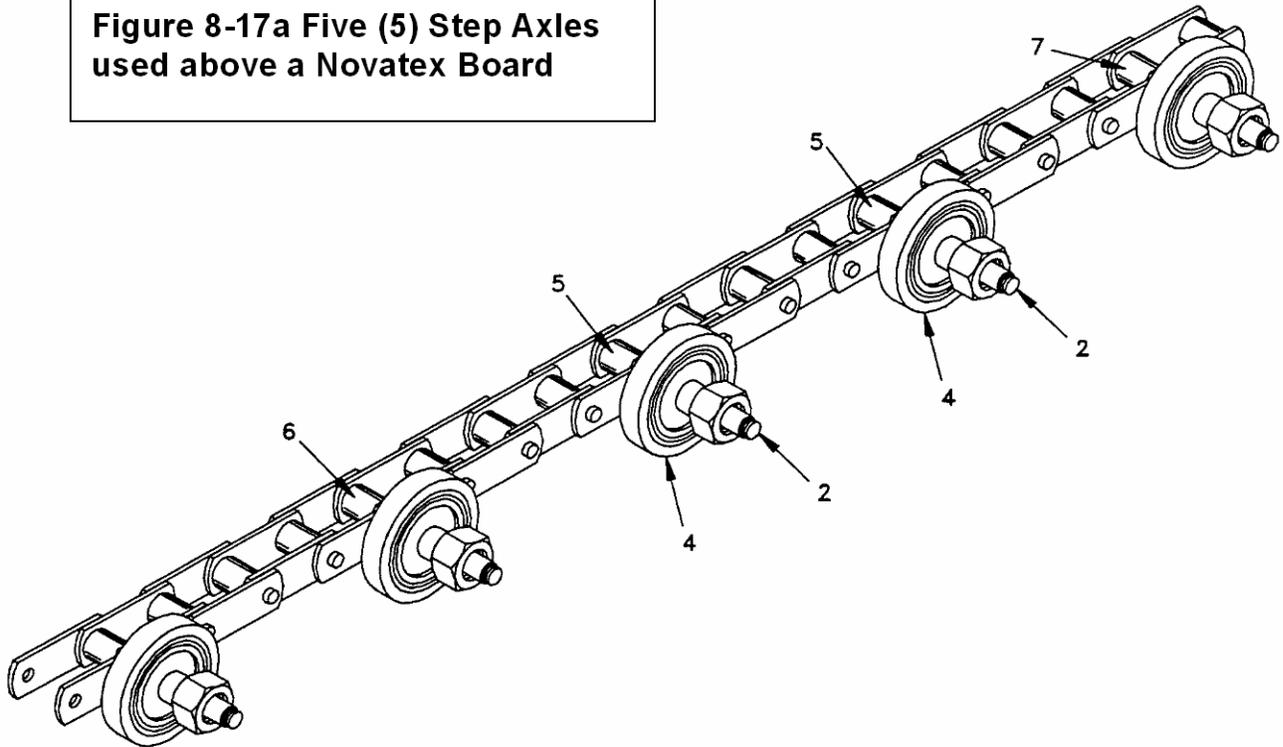
Only three step rollers can be positioned above the lower novatex board. One step roller will be in the middle of the novatex board while the other two are located about 1 inch [25.4 mm] from each end of the novatex board.



S73C-305(10/94)

Figure 8-17 Novatex Board Adjusting Procedures

Figure 8-17a Five (5) Step Axles used above a Novatex Board



S73C-306(9/94)

How properly adjusted novatex boards function

The novatex boards are long enough to be under five step axles at the upper novatex board location and three step axles at the lower novatex board location. However, the novatex boards do not fully support chain rollers at all step axles. The novatex board must be positioned so the apex of the novatex board fully supports chain rollers (5) at MIDDLE step axles (2). Chain rollers on either side of chain rollers (5) will also bear down on novatex boards due to curve of novatex board and curve of track.

The chain rollers (5) at middle step axles (2) are the chain rollers which MUST be fully supported by the novatex board's apex.

If novatex boards are adjusted correctly the following conditions occur.

- Step rollers remain on the track (8) as they enter/exit the area of the novatex board, because the novatex board's top radius is an uncommon radius to the step track.
- Step rollers are gradually lifted above the track .010 to .015 inch [0.25 to 0.38 mm] for a short distance at the apex of the curve, and then are gradually lowered back on to the tracks.
- Finally, the step rollers roll out of the novatex board area. If the novatex board is new, about 14 inches [355.6 mm] of the middle section of the lower novatex board and 59 inches [1498.6 mm] of the middle section of the upper novatex board is contacted — but as the novatex board wears, the contact area gradually lengthens.

G-SI7 (6/94)

Figure 8-17b Proper Setting of Novatex Board under the Chain Roller (barrel)

The importance of adjusting novatex boards

When novatex boards ARE adjusted properly, the combined load of the step weight, chain weight, chain pull force, and live load are all supported by the novatex board. The novatex board must support the **CHAIN ROLLER** at the apex of the board curve. There shall not be any load on the step roller or guide track in that area.

When novatex boards ARE NOT adjusted properly, costly damage to step rollers, step chain, and steps can occur.

G-S16 (4/94)

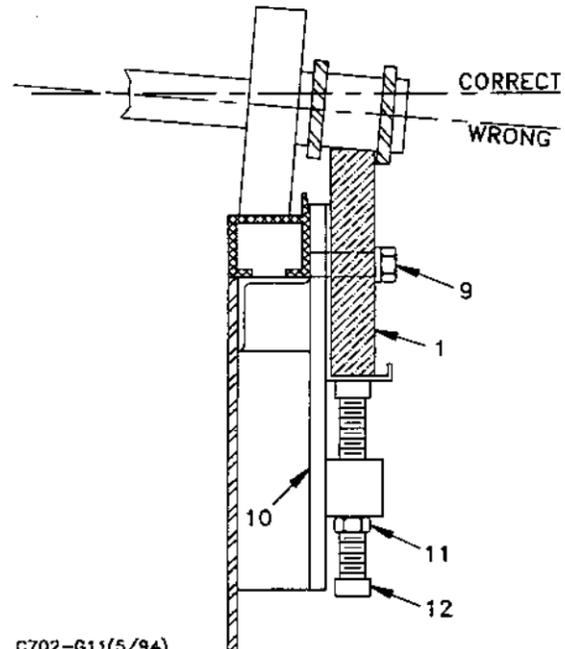
Adjusting novatex boards

Remove eight steps as previously described to allow access to novatex boards, and adjust sets of upper novatex boards and lower novatex boards as follows.

You may also want to remove curved inner panels to have a better view of the components you are adjusting.

Upper novatex boards

1. Make sure step band is clear. Then, turn mainline disconnect ON.
2. Move the step opening downhill a small amount, so fastenings for upper novatex boards can be reached more easily.
3. Turn mainline disconnect OFF after moving step band.
4. Loosen the two through-bolts (9) that secure the upper novatex board (1) to the steel curve plates (10).
5. Loosen the lock nuts (11) on each jack bolt (12), and turn each jack bolt 1/2 revolution to raise the board.
6. Tighten through-bolts (9)



7. After adjusting novatex board, turn the mainline disconnect ON. Reposition step band to original position with five step rollers in position over novatex board with step assembly (3) attached to center roller (4).

Position step axes evenly, with the center of step axle (2) over the centerline of the novatex board.

- After adjusting novatex board, turn the mainline disconnect ON. Reposition step band to original position with three rollers in position over novatex board with step assembly (3) attached to center roller (4).

Position step axles evenly, with the center of step axle (2) over the centerline of the novatex board.

- Turn mainline disconnect OFF.
- Check the clearance between the middle step roller (4) and track (8).
 - There should be .010 to .015 of an inch [0.25 to 0.38 mm] clearance.
- If required, loosen through-bolts (9), and raise or lower the novatex board by adjusting the jack bolts (12) until a minimum .010 inch [0.25mm] feeler gauge can be slid between the middle step roller and the track.

Adjust both ends of novatex board equally to keep novatex board wear balanced, and to get maximum novatex board life.

- Make sure there is .010 to .015 of an inch [0.25 to 0.38 mm] clearance between step roller and track.
 - If there is too much clearance between step roller and track, there will be a noticeable bump when steps pass over the board.

- After boards are correctly adjusted, turn mainline disconnect ON, and relocate opening downhill a small amount to allow better access to jack bolt lock nuts (11).

Never move step band without having through-bolts (9) tight.

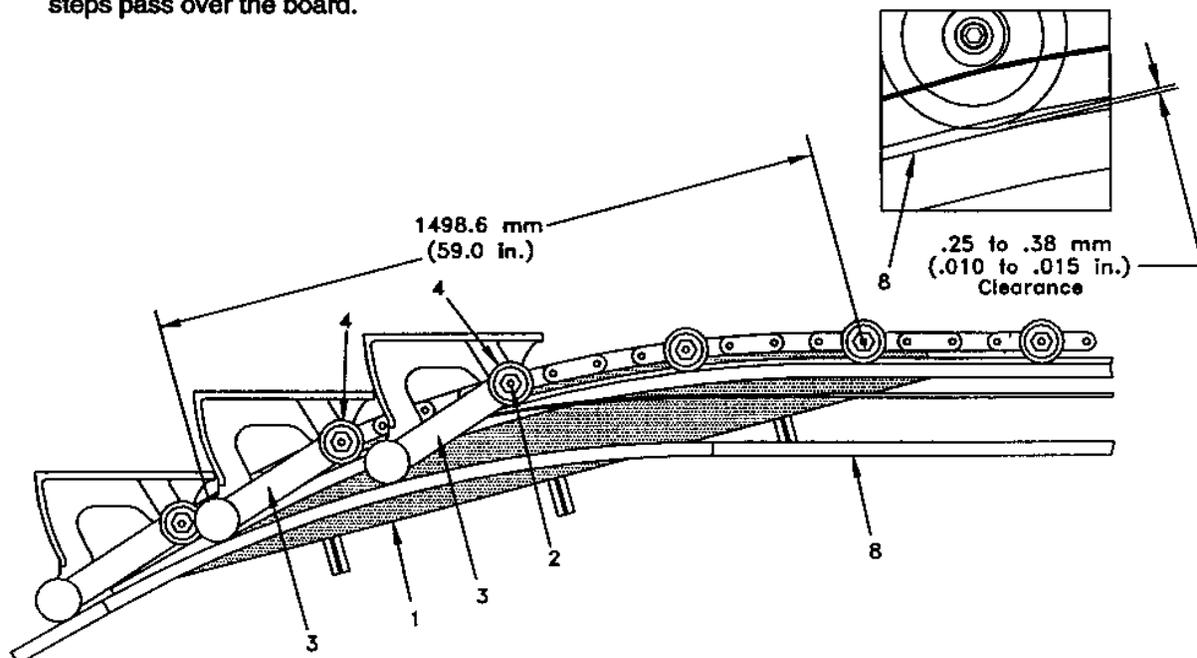
- Turn mainline disconnect OFF.
- Tighten the lock nuts (11) on the jack bolts. Then check the through-bolts (9) to make sure they are tight and will hold the novatex board firmly in place.

Lower novatex boards

- Make sure step band is clear. Then, turn mainline disconnect ON.
- Position opening in step band so fastenings to lower novatex board can be reached more easily. Adjust lower novatex board in the same manner as the upper novatex board.
- Before starting escalator, check the lower reversing station spring tension and broken step-chain switches.

Adjustment of novatex boards will usually shorten the lower reversing station spring length, so it is important to check and reset the spring length to the specified original setting of 13-7/8 inches [352.4 mm].

700-G14 (1/87)



S73C-305(1/97)

Figure 8-17c Adjusting Lower Novatex Board

REVIEW QUESTIONS: Write your name and answer in a separate piece of paper.

1. With your weight on the step above the novatex board, what is the status of the **step rollers**?
 - a) Slides slightly through.
 - b) Very tight to spin.
 - c) Does not turn.
 - d) Free to spin.

2. With your weight on the step above the novatex board, what is the status of the **chain rollers**?
 - a) Slides slightly through.
 - b) Very tight to spin.
 - c) Does not turn.
 - d) Free to spin.

3. What best describes the **reason to adjust** the novatex boards? Costly damage to the _____.
 - a) step rollers, steps, and step threads,
 - b) step chain, step rollers, and steps,
 - c) step chain, step rollers, and steps
 - d) novatex board apex

4. How much are the step rollers lifted as the step travel on top of the novatex board apex? ____ inch
 - a) 0.010 to 0.015
 - b) 0.100 to 0.150
 - c) 0.001 to 0.0015
 - d) 1.00 to 1.50

5. A noticeable bump when the steps pass over the novatex board is caused by? The _____.
 - a) board is badly worn.
 - b) board is adjusted very low.
 - c) step chain is not tensioned
 - d) board is raised above its maximum clearance

FIELD PRACTICAL SKILL TEST,

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Perform PM of the Novatex Boards;

- 1. Access Montgomery escalator Novatex Boards to clean, inspect and to check for proper step and chain rollers clearance.**

- 2. Access Montgomery KONE escalator Novatex Boards at the non-passenger side to clean, inspect and to check for proper step and chain rollers clearance.**

Inform the Station Agent and Central Control that escalator _____ is back to service.

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Unit 18: Machine Room, Controller, Drive Motor & Coupling

CAUTION:

AVOID ANY CONTACT WITH LIVE CIRCUIT.

Tagout and lockout circuit breaker whenever you access the stepband and the controller.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

Wear suitable work glove, a broom, a wide blade spatula or a dustpan to pick up debris.

Avoid using bare hand in picking dirt and debris to avoid contact with bloodborne pathogens.

Dispose all debris and hazardous materials in the proper disposal area or container.

Clean dirt, debris, oil drip, and any fire hazard materials.

Avoid using any abrasive cleaning material to an AC motor winding. Extra care must be observed not to cut through wire insulation.

Machine Room, Controller, Drive Motor and Coupling

Objective: Upon completion of this training, an Elevator/Escalator Trainee should be able to clean and inspect;

- Machinery room.
- Escalator controller.
- Motor and motor bearings and coupling.
- Lubricate motor bearings.

A. Machinery Room; Clean

Do not store any flammable materials such as lubricant, solvent or oily rags inside the machinery room. Items unrelated to escalator maintenance/ operation shall **not be stored** in the machine space.

Do not enter drive or return areas unless the step lock or bull gear interlock device is engaged.

If applicable, inspect fire extinguisher. Dismount and loosen the extinguisher content by turning it up side down twice. Replace annually or when used.

Machine located inside the stepband. Remove 5 steps.

- Move missing step above the machine.
- Tagout and lockout the circuit breaker.
- Turn OFF motor pit stop switch located in the stepband.
- Engaged step lock or bull gear interlock device.
- Clean the surfaces of the motor and the gearbox.

Clean Oil Pans

- Dispose collected oil from the drip pan at proper disposal container.
- Note any excessive oil leak from any gear case and look for the source. Correct or repair any damage to avoid fire and personnel hazard.
- Clean bottom and top pit drip pans. Install oil absorbent in and around the pit. Replace dirty or oily absorbent. Dispose oil soaked absorbent at proper disposal container.

B. Controller; Clean and Inspect

- **Tagout and lockout controller circuit breaker or the quick disconnect switch.**
- **Check all circuits to make sure there is no voltage present. Tagout and lockout source voltage for demarcation lights.**
- **Tagout and lockout foreign voltage relay (FVR) contacts connected to the 277vac for signage lightings.**
- **Avoid prolonged exposure to contact cleaner if in used.**

Clean dust and dirt from the controller cover before opening.

Insure that the controller ground cable to the building ground is secured an not corroded.

Open and clean the inside of the controller. Use low-pressure air if available. Vacuuming with non-metallic nozzle is highly recommended.

Check, isolate and seal any oil or water drip into the controller. It must be free of moisture and any contaminants entry.

Look for frayed cabling or burnt insulation which may be an indication of over current or overloading in the circuit.

Inspect each wire from their terminals for proper tension/tightness and to insure all wire strands are inside their respective slot. Do not over tighten terminal screws that may break wire strands.

Check for proper size of fuses, and must not be jumped or show evidence of tampering.

Clean and inspect switches, contactors, relays and their electrical connections to ensure they are in good condition.

If arc chutes or spark suppressors are installed between contactors, make sure they are in place as shields before any test is to be performed.

Clean or replace contacts that are worn. Do not use abrasive materials for cleaning contacts. Use a clean rag or contact cleaner. To clean contacts, lay pitted contacts on the cleaning surface and follow figure eight (8) to maintain contact surface contour. Contactors must be replaced in set.

Tighten loose screws. Avoid over tightening to cause stripping of treads.

Check all relays and contactor coils for frayed or burnt insulation. Make sure that the coils are not coming off or separating around their iron core. A loose coil off its iron core will push and open contacts through vibration and is hard to detect as fault.

Insure that all electrical **cabinets must closed and latched** to prevent shock hazard and entry of dirt, water and oil spray or any form of contaminants.

Remove tagout or lockout to turn on circuit breaker(s) or quick disconnect.

- Make sure that personnel near moving parts are notified that the circuit is to be energized.
- **Run the escalator and visually inspect relays and contactor armature.** When energized, all contacts are fully pick-up or fully close to reduce contact arcing.
- **Insure all movable contacts or armatures** are not binding or sticking and are free to move.

C. Motor & Coupling; Clean and Inspect, Lubricate Motor Bearings

CAUTION: Tagout and lockout the circuit breaker. Engage the pawl brake system.

Remove six to eight steps for escalators with machine inside the upper truss.

Insure that the motor ground cable to the building ground or truss ground is secured and not corroded. Clean grounding cable where evidence of corrosion is present.

Clean electric motor housing, vacuum vent screen and stator windings.

Use “Megger” periodically to ensure that the integrity of the winding insulation has been maintained.

Check motor mount, aligning/adjusting bolts, and taper pins (figure 8-18 p7) for tightness, alignment or vibration. Insure all fasteners are secured.

Oil/grease slinger if installed around the shaft between the motor and the gear box shall be maintained to protect motor windings and the brake assembly from oil contamination. Inspect for oil or grease creepage inside the motor.

Remove bearing covers at motor end and gear box to lubricate bearings.

Remove tag and lock to run the unit.

Observe an **excessive backlash of the rotor shaft** which may be caused by:

- **Thrust Bearing “Thrust play”**. Watch the movement of the worm shaft. If the horizontal movement is excessive, the thrust bearing should be replaced.
- **Wear of the Worm**: Open the gear box to inspect worm gear wear. One third of the worm gear should be above the oil level. Check the lock key between the gear and the motor shaft to insure they are properly secured.
- **Wear on the Gear**: Worn out gears may show uneven wear pattern of gear teeth and an indication of metallic contaminants in the gear oil. When an excessive wear is detected on the teeth of the gear, replace the gear and gear oil. Inspect gear shaft bearings for wear to be secured.

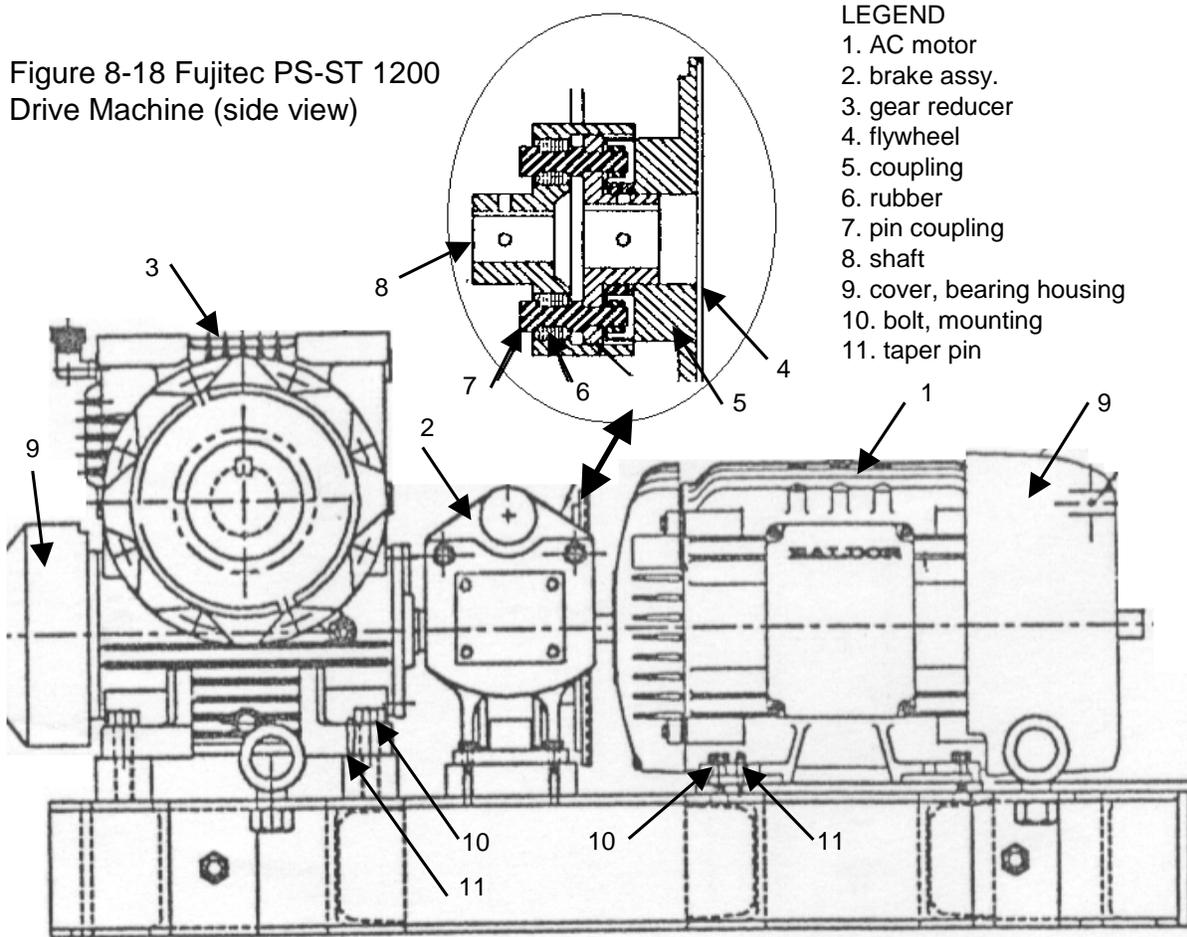
Inspect the shaft coupling and bushing;

- Shut down the escalator if unusual vibration or noise is present.
- Inspect the motor alignment against the gear box. Use a dial indicator to check true motor alignment. Misaligned motor will accelerate the damage to the coupling and the bearings.
- Inspect the key and key way and lock washer if installed for wear and looseness. Replace worn parts.
- Inspect Montgomery and Montgomery KONE coupling grommets for wear.
- Replace worn parts.

Fujitec PS-ST 1200 figure 8-18 below.

- Before tagging out the escalator, run the unit and listen to vibration, large beating sound and watch for coupling excessive play from an improperly aligned motor and worn coupling spider.
- Inspect coupling pins (7) and neoprene cushion rubber (6) for wear. Replace worn pins and/or rubber indicated by loose coupling, vibration and beating sound. Beating sound from the coupling can be detected during starting, stopping and change in load.

Figure 8-18 Fujitec PS-ST 1200 Drive Machine (side view)



- Check for excessive play and minimum thickness of the cushion rubber. Never operate the escalator if the wear is **beyond 25% of original thickness** (figure 8-18a p8). Replace the spider if cracked or hard to touch, or realign the coupling, motor and gear reducer.

Inspect, listen, and lubricate all bearings.

- Operate the escalator by making several stops to check the bearings for excessive heat.
- Listen to any metallic grind, a rattling noise or an excessive vibration which may be an indication of bad bearing or an unbalance rotor and rotor shaft.
- During the operation, inspect motor and reduction gear fastening for evidence of movement which may indicate improper tightness.
- Clean bearing grease fittings and remove grease drain plug. Add grease slowly with a pressure gun until new grease appears from the outlet plug. Clean excess grease.
- If grease is hardened, remove hardened lubricant that has accumulated around the refill or the drain plug with a plastic stick. Hardened grease on motor bearings may cause an overflow to windings and brake assembly.

CAUTION: DO NOT OVER LUBRICATE bearings.

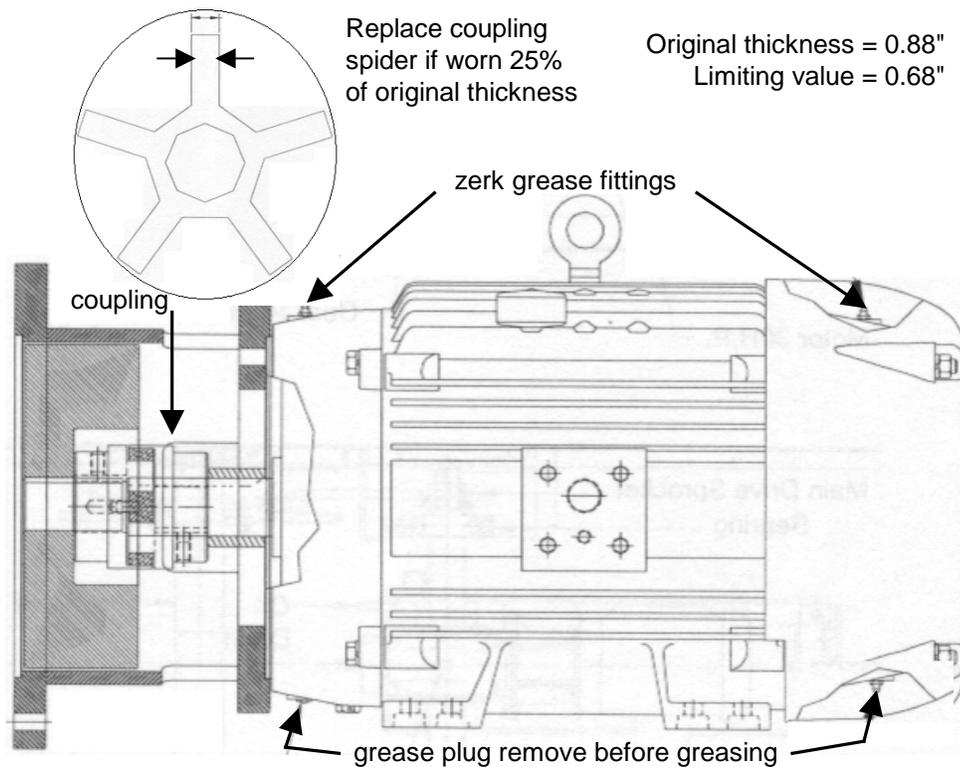


Figure 8-18a Fujitec PS-S 1200 Motor Grease Fittings & Coupling

NOTE: Imperial electric motors are properly lubricated and thus do not require lubrication when installed.

- Re-grease motor bearings with a low pressure hand operated grease gun while the motor is at standstill.
- Run the motor for 20 minutes after re-greasing until the new grease flows from the drain plug. For optimum operation, the **bearing chamber should be 2/3 full of grease.**
- Replace grease plugs. Clean and wipe off any excess or spilled lubricants around the shaft towards the windings and the brake assembly.
- Lubricate **sleeve bearing** where applicable (Westinghouse Escalator 38E machine figure 8-18b). Clean the surroundings of the oil cap, check and refill oil well or a carrier if less than 1/3.
- Inspect all fasteners and hardware to be secured.
- Remove the pawl brake system, tagout and lockout.
- Reinstall steps for machine located in the truss.

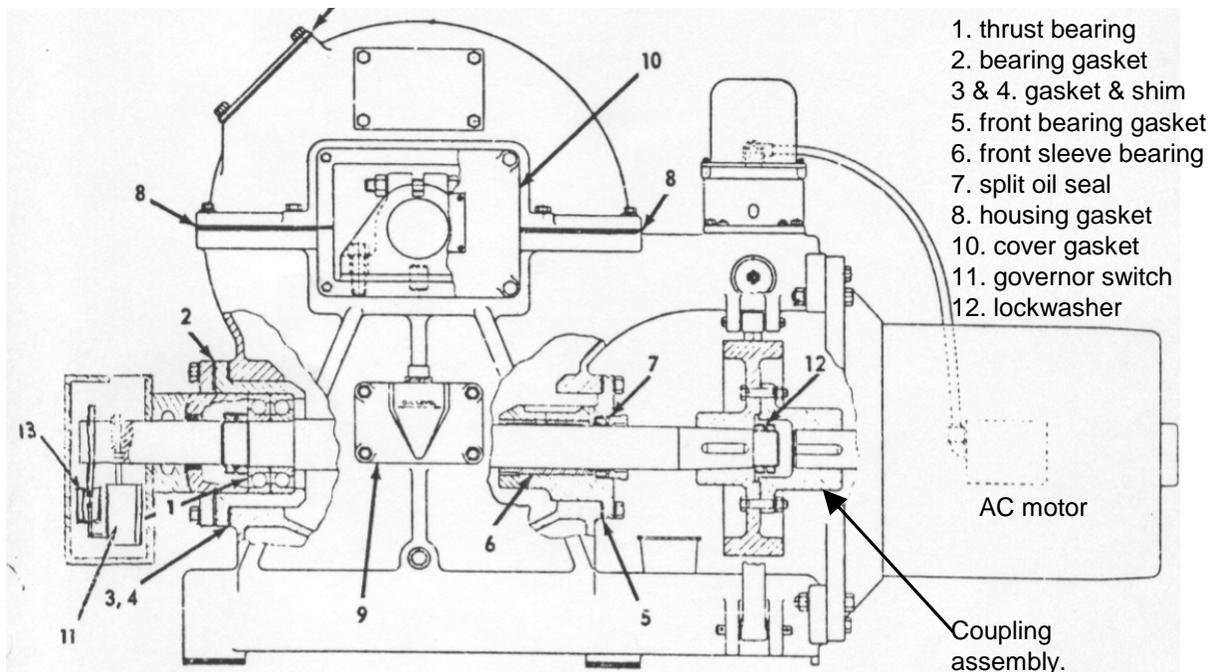


Figure 8-18b Westinghouse Escalator 38E Geared Machine Assembly

Use the table below for re-lubricating guide in months for ball bearings.

Ball bearing re-lubricating guide in months for motors operating in ambient temperature of 0° to 100° F.

Condition	Motor RPM	
	1800 R P M	3600 R P M
1	12 mo.	6 mo.
2	6 mo.	3 mo.
3	3 mo.	3 mo.

Identify the Origins of Bearing Failures and Deficiencies. **The general classifications of failure and deficiencies requiring bearing removal are:**

1. **Overheating;** a) inadequate or excessive lubrication, b) grease liquefaction or aeration, c) oil foaming, d) abrasive or corrosive due to contaminants in bearing and improper handling, e) distortion of housing due to warping, or out-of-round, f) seal rubbing or failure, g) inadequate or blocked scavenge oil passages, h) inadequate bearing-clearance or bearing-preload, i) cage wear.
2. **Vibration;** a) dirt or chips in bearing, b) fatigued race or rolling elements, c) race turning, d) rotor unbalance, e) out-of-round shaft, f) race misalignment, g) housing resonance, h) cage wear, i) flats on races or rolling elements, j) excessive clearance, k) corrosion, l) false-brinelling or indentation of races, m) electrical discharge (similar to corrosive effects), n) mixed rolling element diameters.
3. **Noisy Bearing;** a) lubrication breakdown, inadequate lubrication, stiff grease, b) contamination, c) pinched bearing, d) seal rubbing, e) loss of clearance and pre-loading, f) bearing slipping on shaft or in housing, g) flattened roller or ball, h) brinelling due to assembly abuse, handling, or shock loads, i) vibration in size of rolling elements.

Reinstall all covers and steps. Remove tagout and lockout. Operate the unit to check for normal operation.

REVIEW QUESTIONS: Write your name and answer in a separate piece of paper.

1. What is the minimum thickness of the Fujitec neoprene cushion rubber?
 - a) No more than 25% of original thickness.
 - b) No less than 25% of original thickness.
 - c) No less than 2/3 of original thickness.
 - d) No more than 2/3 of original thickness.

2. A worn motor bearing may show all of the following symptoms except ____?
 - a) Noise
 - b) Sparking
 - c) Vibration
 - d) Overheating

3. How much grease should be used to replenish motor bearing chamber?
 - a) Only when needed
 - b) 2/3 of the chamber
 - c) 3/4 of the chamber
 - d) When you feel rejection from the grease pump pressure.

4. What type of grease gun should you use to replenish motor bearings?
 - a) Electric operated
 - b) Low pressure
 - c) High pressure
 - d) Medium pressure

5. Worn contactors must be replaced, _____.
 - a) in sets
 - b) in pairs
 - c) only when pitted
 - d) only the worn ones

FIELD PRACTICAL SKILL TEST

Inform the Station Agent and Central Control that escalator _____ will be out of service for preventive maintenance and training.

Demonstrate how to access the machine room to clean, run, observe and to inspect and lubricate motor bearings, coupling, and shaft of;

- 1. Westinghouse 38E and 48N escalators.**
- 2. Fujitec PS-ST 1200 escalator.**
- 3. Montgomery escalator.**

Inform the Station Agent and Central Control that escalator _____ is back to service.