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Level 2

Signalling Design: Module B8 -

Interlockings – Lever Frame Interlocking Guidelines

Endorsement and Authorisation

For endorsement and authorisation, please refer to NR/L2/SIG/11201

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Issue record

Issue	Date	Comments
4	June 2011	Modularisation of handbook and guidance notes, contains content of former NR/GN/SIG/11600, Appendix F1.

Compliance

This Module is mandatory and shall be complied with by Network Rail and its contractors if applicable from 03/09/2011.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 3 (Option Selection) to continue to comply with the issue of any relevant Network Rail standards current when GRIP Stage 3 was completed and not to comply with requirements contained herein, unless stipulated otherwise in the scope of this standard.

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1 INTRODUCTION

This module describes the design of lever frames and associated interlocking. See also the mechanical handbook, [NR/GN/SIG/19014](#).

Although this module is not in itself mandatory, use of mechanical locking will satisfy the principles given in Section 2 of this Part of the Standard if the appropriate sections are complied with. The application of the principles and requirements to mechanical and electro-mechanical interlockings are summarised in Sections 4 and 5, respectively.

The design details required for a mechanical interlocking are described in [NR/L2/SIG/11201, Module A2](#). Examples relating to the typical layout shown in Figure:10 are given in Figures:11 to 14.

Most of the locking terms used in this Module are illustrated in the figures. Where other former regional terms are found describing these items, care should be taken to avoid ambiguity. For instance, locks and notches are also known as nibs (or wedges) and ports. Tappets can be known as swords, irons or blades. Locking bars can be referred to as bridles, and studs as drivers.

Note that imperial dimensions are used in this Module, viz:

1 inch (")	=	25.40mm
12"	=	1 foot (');
3'	=	1 yard.

2 LEVER FRAMES

The main development of the mechanical locking frame was from the 1860s to the 1920s, but installation and reconditioning of lever frames has continued, albeit at a decreasing rate, until modern times. Currently in the region of seven hundred mechanical frames remain in use on Network Rail controlled infrastructure, comprising some fifty distinct types. These are listed in Figure:1 and some of the most common are illustrated in Figures: 2 to 9. Their life expectancy can be seen from the fact that many of the frames in use today are over a hundred years old. There is no prohibition on the introduction of new or reconditioned mechanical locking frames, provided the necessary risk assessment is undertaken in accordance with Section 2.2.

Type of Frame	Commonly Found in Areas	Lever Centres (inches)	Method of Operation/ Actuation	Type of Locking	Illustrated
British Power (power slide frame)	ABP	2 or 2½	lever (r/t)	tappet	Fig: 9(c)
Cheshire Lines Committee (similar to Stevens Tappet)		5	lever (d/a)	tappet	
Dutton 1893		4 or 4½	catch handle	tappet	
Dutton Combination		4½	c/h & lever	tappet	
Evans O'Donnell		4	catch handle	tappet	
Gloucester Wagon Company		5	lever	tappet(r/l)	
Great Central (similar to RSCo LNER Standard)	GCR	4½	lever (d/a)	tappet	
Great Northern - East Lincolnshire		4¼	lever (d/a)	tappet	
Great Northern Duplex (aka McK & Holland No.26) sim to S&F 1905		4	c/h & lever	tappet	
Great Western 3 Bar Horizontal Tappet	GWR	4	lever (r/t)	tappet	Fig: 2(a)

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Great Western 3 Bar Horizontal Tappet	GWR	5¼or5½	lever (r/t)	tappet	
Great Western 3 Bar Vertical Tappet	GWR	4	lever (r/t)	tappet	Fig: 2(b)
Great Western 5 Bar Vertical Tappet	GWR	4	lever (r/t)	tappet	
Great Western Double Twist	GWR	5¼	lever	tappet(r/l)	
Great Western Stud (mostly relocked)	GWR	4 or 5¼	lever (grad)	LLB/DN	
Lancashire & Yorkshire (v sim to Railway Signal Company Tappet)	L&YR	5½	lever (d/a)	tappet	
London & North Western Tappet	LNWR	5½	catch handle	tappet	
London & North Western Tumbler 1876 (Bar & Stud)	LNWR	5½	lever (esc)	LLB/BC	Fig: 3
London Midland 1943	LMR	4½ or 6	catch handle	tappet	Fig: 4(b)
London Midland & Scottish 1938 (development of LNW Tappet)		4½	catch handle	tappet	
London, Brighton & South Coast 1880 (similar to S&F 1874)	LBSCR	5	lever (d/a)	tappet	
London, Brighton & South Coast 1905	LBSCR	5	lever (d/a)	tappet	
London, Brighton & South Coast Bosham Pattern		5	lever (d/a)	tappet	
London, Chatham & Dover		4¼	lever (d/a)	tappet	
Manchester, Sheffield & Lincolnshire		6	lever (d/a)	tappet(r/l)	
McKenzie & Holland 1873 Hook, Cam & Soldier	LMR	5 or 6	lever (esc)	LRS	
McKenzie & Holland No.11 (5") / No.12 (4") 1886 T-Bar	ER, NER	4 or 5	lever (esc)	LRS	Fig: 5
McKenzie & Holland Cam & Tappet		4	lever (r/t)	tappet	
McKenzie & Holland / Westinghouse No.16 (5") / No.17 (4")	NER	4 or 5	lever (d/a)	tappet	Fig: 6
McKenzie & Holland / Westinghouse No.17A (deep locking boxes)	ER	4	lever (d/a)	tappet	
McKenzie & Holland No.21 (aka Brettell Duplex Tappet)		4	lever (d/a)	tappet	
Midland Tappet	MR	6	catch handle	tappet	
Midland Tumbler	MR	6	catch handle	LLB/TRS	Fig: 4(a)
North London Tappet (similar to Stevens Tappet)		5½	lever (d/a)	tappet	
Railway Executive Committee	LMSR	4½	catch handle	tappet	
Railway Signal Company / Edwards 1877 (Bar & Stud)		5½	lever	tappet(r/l)	
Railway Signal Company Tappet	ER, LMR	5½	lever (d/a)	tappet	Fig: 7(a)
Railway Signal Company London & North Eastern Standard		4 or 4½	lever (d/a)	tappet	
Railway Signal Company Great North of Ireland	ER	4	lever (d/a)	tappet	
Saxby & Farmer 1874 Rocker & Gridiron (mostly relocked)	ER, SR	4 or 5	catch handle	LLB/TRS	
Saxby & Farmer 1888 Duplex	ER, SR	4	c/h & lever	tappet	
Saxby & Farmer 1905 Duplex	ER, SR	4 or 4½	c/h & lever	tappet	Fig: 7(b)
South Eastern Cam / Brady		5	lever (d/a)	tappet(r/l)	
South Eastern Tappet (Old Pattern)	SER	4½	lever (d/a)	tappet	
Stevens Knee Frame	SR, ScR	5 4 / 8	lever (d/a)	tappet	
Stevens Tappet	ER, SR	4 to 5¼	lever (d/a)	tappet	Fig: 8(a)
Stevens / Caledonian (similar to Glasgow New Pattern)	ScR	4¼or5¼	lever (d/a)	tappet	
Stevens Glasgow (Old Pattern)	ScR	4¼or5¼	lever (d/a)	tappet	
Stevens Glasgow (New Pattern)	ScR	4¼or5¼	lever (d/a)	tappet	
Stevens / Glasgow & South Western (New Pattern)	ScR	4¼	lever (d/a)	tappet	
Stevens / McKenzie & Holland No.28 (similar to No.17 & Stev Tap)		4	lever (d/a)	tappet	
Sykes & Hallam (aka South Eastern & Chatham New Pattern)		4½	lever (r/t)	tappet	
Tyer Direct Tappet		4	lever (d/a)	tappet	
Tyer Knee Frame		5½	lever (d/a)	tappet	
Westinghouse 1924 Type A2 / 1948 Type A3	ER, SR	4	catch handle	tappet	Fig: 8(b)
Westinghouse Style K / Style N (miniature lever power frame)	LT	2½	lever (vert)	LLB/TRS	Fig: 9(a)
Westinghouse Style L (miniature lever power frame)	SR	2½	electrical	electric	Fig: 9(b)

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Notes Method of Actuation:-		Type of Locking (non-tappet):-
Lever Locking: d/a	= direct action	LRS = longitudinal rotating shafts; or
r/t	= reduced travel	LLB = longitudinal locking bars
(non-tappet) esc	= escapement gives initial & final motion	with motion transmitted by:
grad	= gradual motion gives early lock & late	BC = bell cranks;
release		DN = diagonal notches; or
vert	= vertical shaft	TRS = transverse rotating shafts.
Duplex Locking:	c/h & lever = catch handle and lever locking	r/l = all surviving examples relocked with tappet locking
Longitudinal means running parallel to the length of the frame. Transverse means in the plane that the lever moves and at right angles to the length of the frame. Ground frames are not included in the table. Some frames were made by different manufacturers and the parts are not necessarily interchangeable, e.g. parts for the McK&H No16/17 frames made by Butterworth & Dickinson.		

Figure 1 – Existing Types of Lever Frame

The signaller's control device is a lever connected to mechanical and/or electrical interlocking that prevents movement of levers, depending on the position of other levers. The levers may be connected to trackside signalling equipment which they operate mechanically (using wires for functions requiring pull only with the return usually being self-acting, e.g. signals, and rodding where both pull and push forces need to be transmitted, e.g. points), or electrically as described in Section 5.

The levers should be arranged in a frame, so as to give the signaller a clear view of the line and as much of the trackside signalling equipment being controlled as reasonably practicable. Indicators should be provided for any equipment that is not clearly visible to the signaller, or where electrical proving is provided for other purposes. Except where track circuit block is provided to all adjacent signal boxes, the frame should be arranged to give the signaller ready access to the signal box windows.

The frame is generally elevated to permit the mechanical locking and other apparatus to be situated within the space below the operating floor. The frame should be adequately supported. Alternatively, ground frames may be provided, as described in Section: 8.

2.1 ACTUATION OF LOCKING

The locking apparatus is generally actuated as follows:

- by the motion of the lever (direct action or lever locking) with the locking acting on the lever (see Figure:14, for example);
- by moving the catch handle (catch handle locking) with the locking acting on the catch handle, e.g. Figure:8(b); or
- by some combination or permutation of the above, e.g. duplex locking, which may have one set of tappets connected to the lever and another to the catch handle. See Figure:7(b).

2.2 PREVENTION OF CONFLICTION

The locking should generally be effected at or before the start of each stroke and should release only at or after the end of each stroke. Additionally, it should not give rise to confliction during the travel. This may be achieved by one of the following means:

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- a) by the use of catch handle locking, where the catch handle operates a rocker that is attached to the locking, e.g. Figure:4(b);
- b) by incorporating a reduced travel mechanism, such as a cam, into lever locking, so as to give escapement with initial and final motion, as shown in Figure:2(a); or
- c) in the case of direct action lever locking tappet frames (i.e. where the tappet stroke is directly related to the motion of the lever), by taking special precautions to avoid conflicting notches (see Section: 5.1).

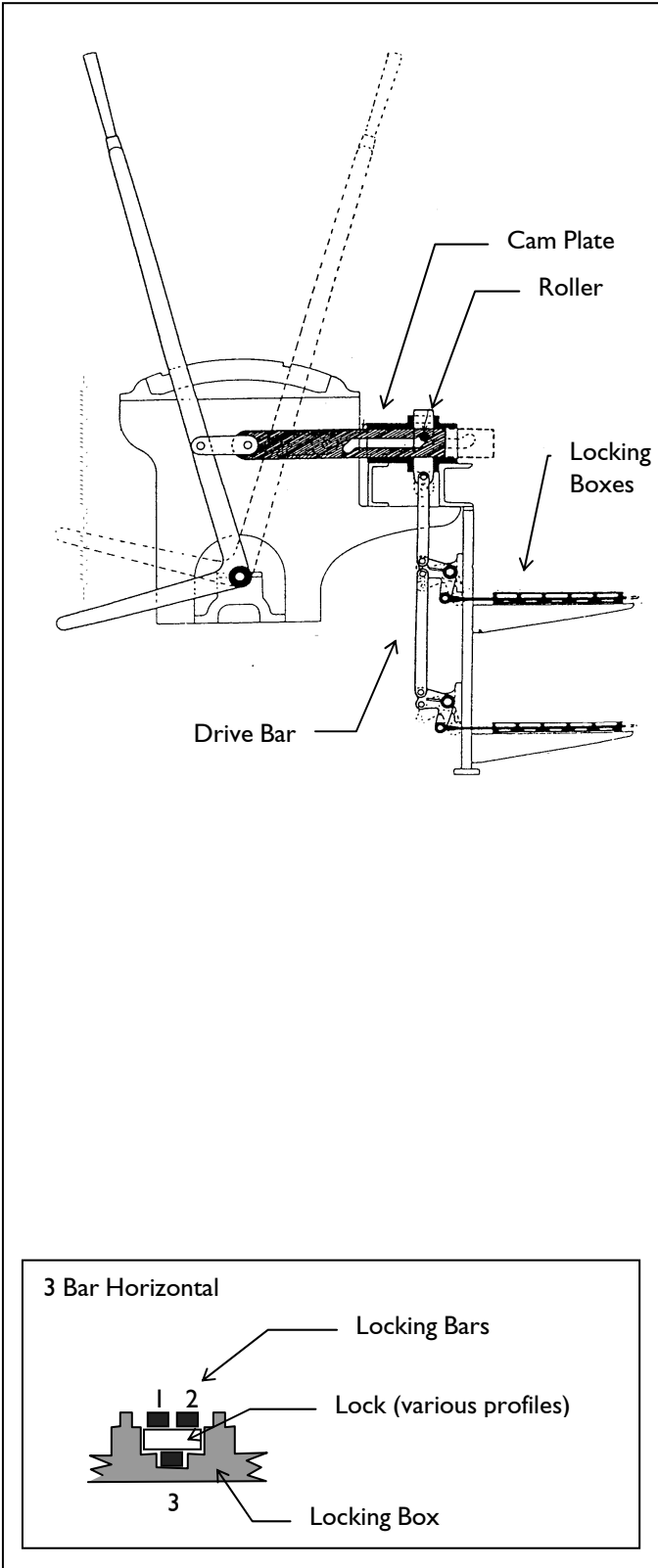
2.3 BASIC REQUIREMENTS

Mechanical locking frames should have the following attributes, as far as reasonably practicable:

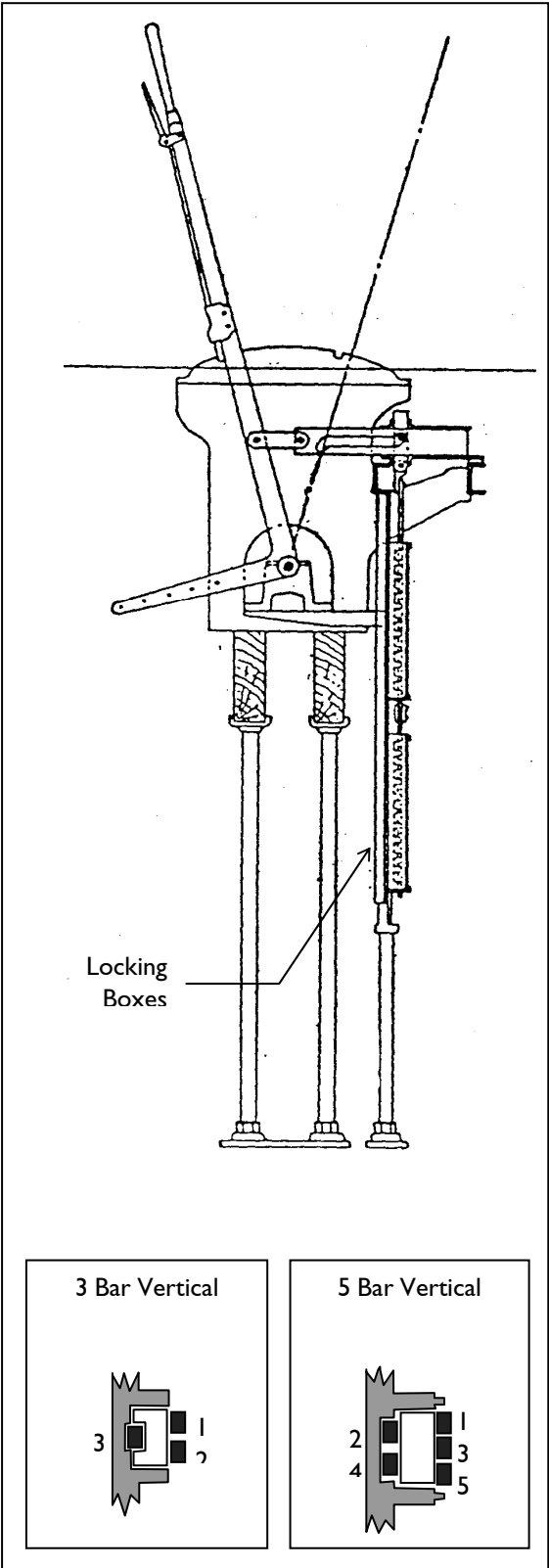
- a) simple construction;
- b) minimising the number of pins or links between the lever or catch handle and the locks, so as to reduce the risk of slack locking;
- c) strong and effective locks;
- d) broad wearing surfaces for wearing parts;
- e) accessibility of locking for maintenance and alteration;
- f) arrangement of the frame to allow for easy extension and replacement of parts;
- g) locking design not to limit the size of frame that can be conveniently constructed.

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(a) GW Horizontal Tappet Frame



(b) GW Vertical Tappet Frame

Figure 2 – Great Western Tappet Frames

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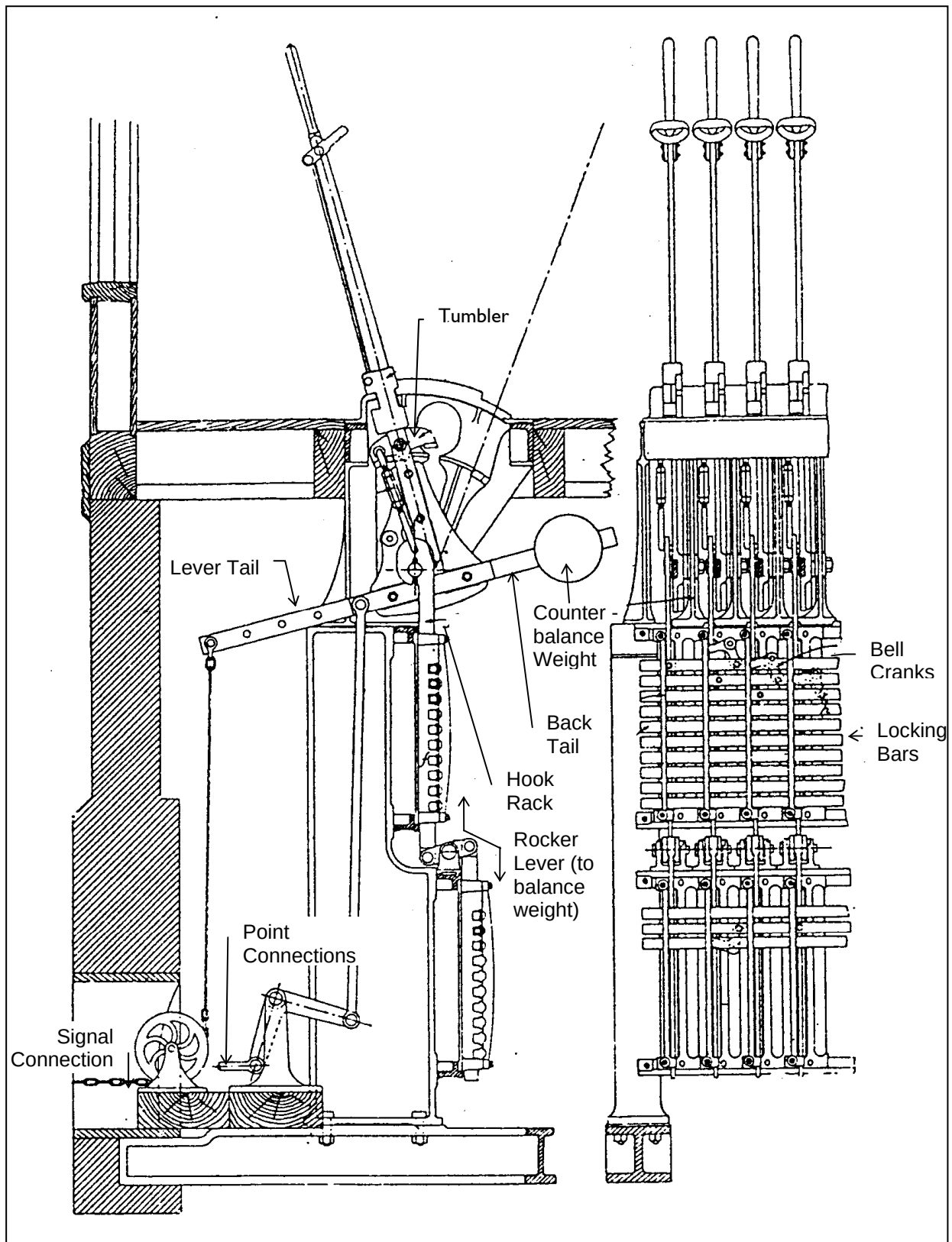
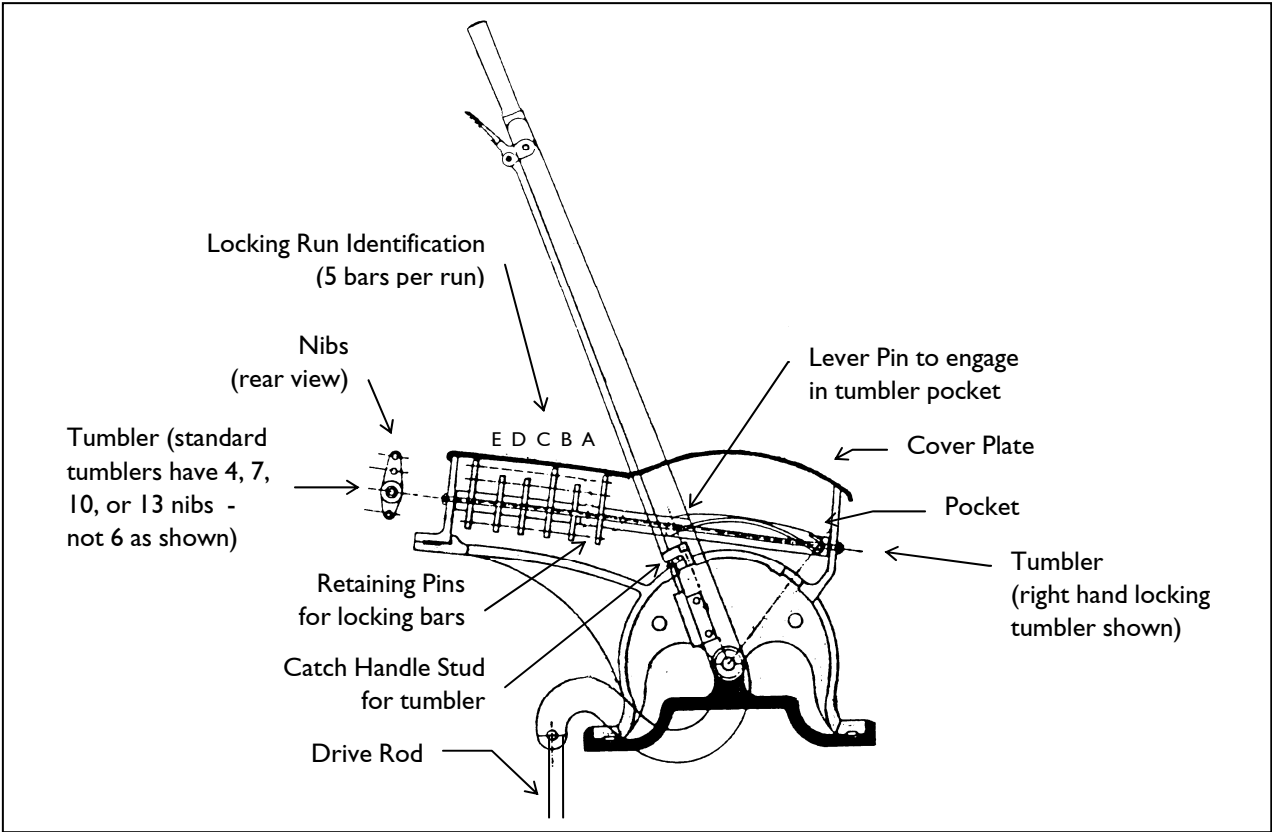


Figure 3 – London and North Western Tumbler Frame (non-tappet locking)

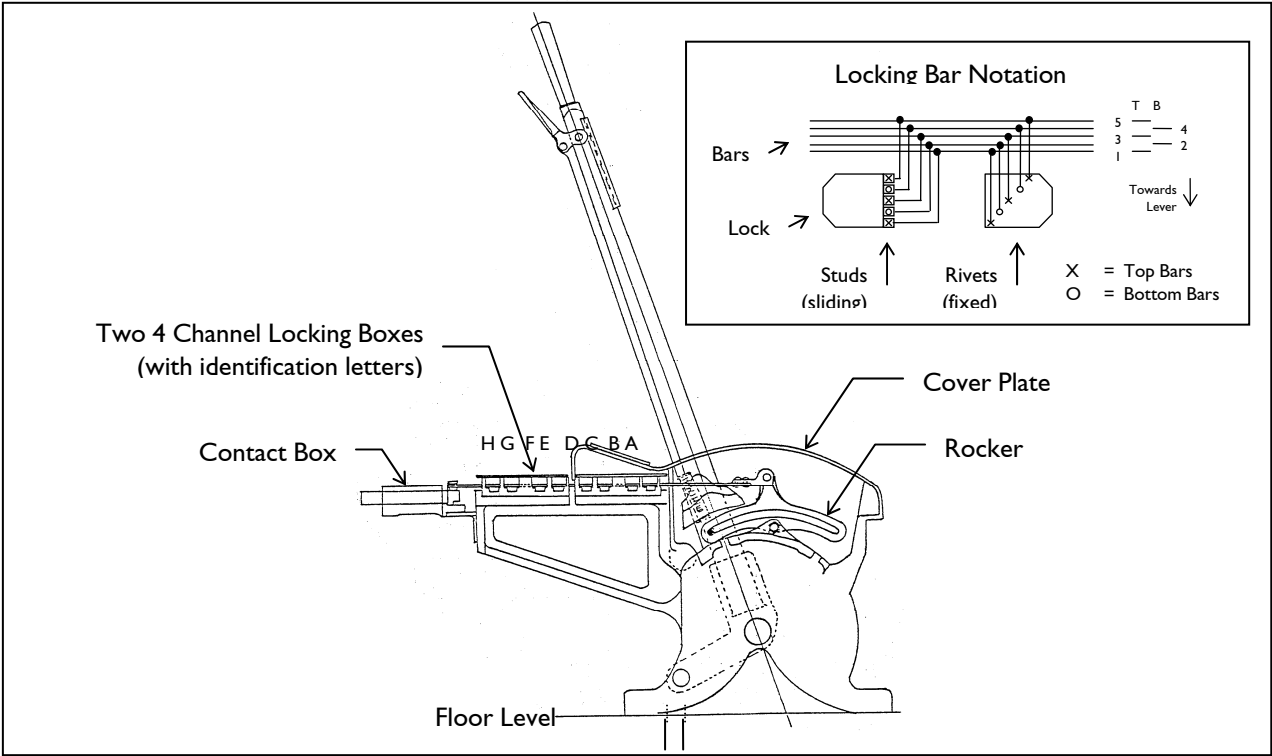
See Section: 3.2 for details

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(a) Midland Tumbler Frame (non-tappet locking)

See Section: 3.3 for details



(b) London Midland 1943 Frame (catch handle locking)

Figure 4 – Midland Type Frames

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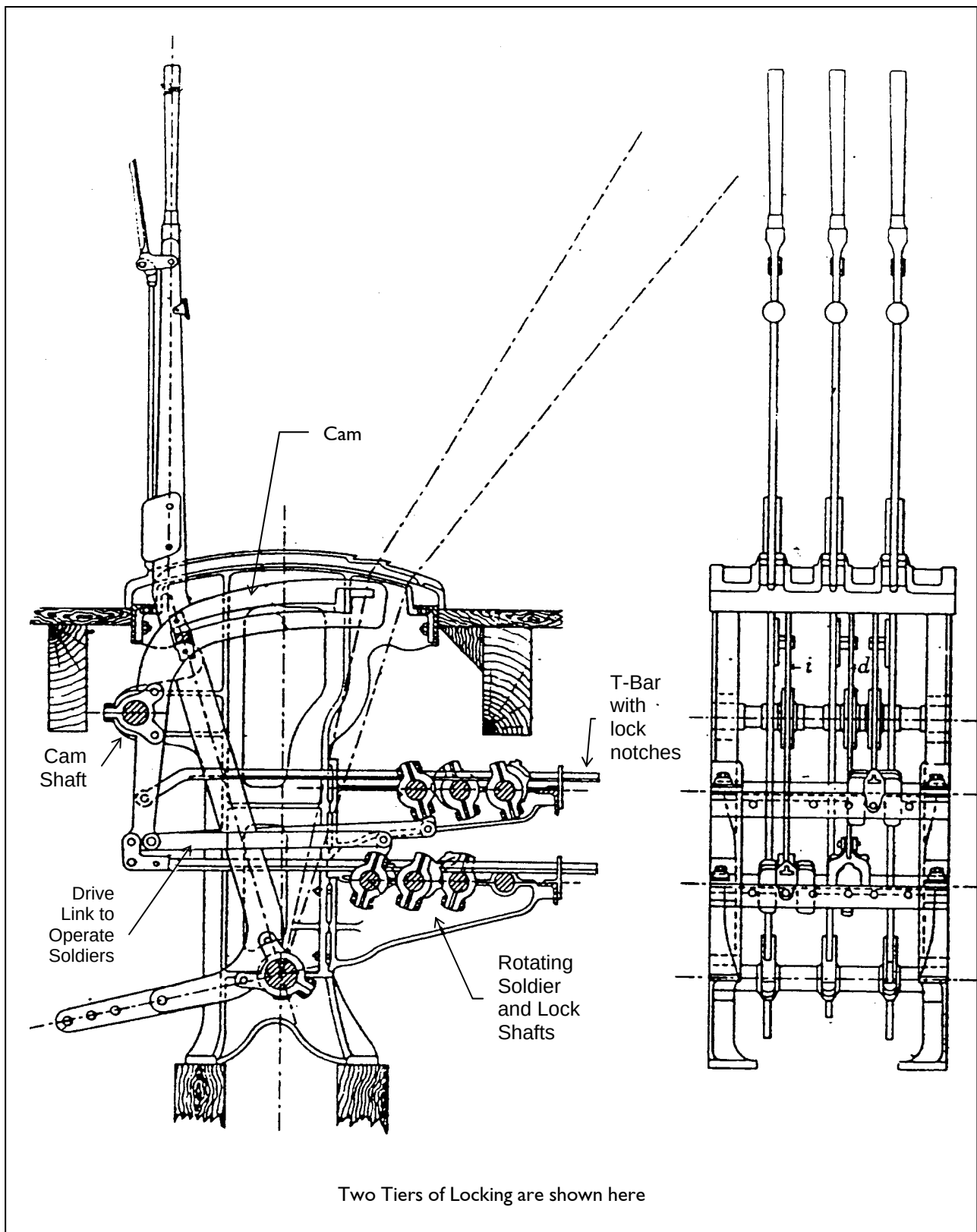


Figure 5 – McKenzie & Holland 1886 T-Bar Frame (non-tappet locking)

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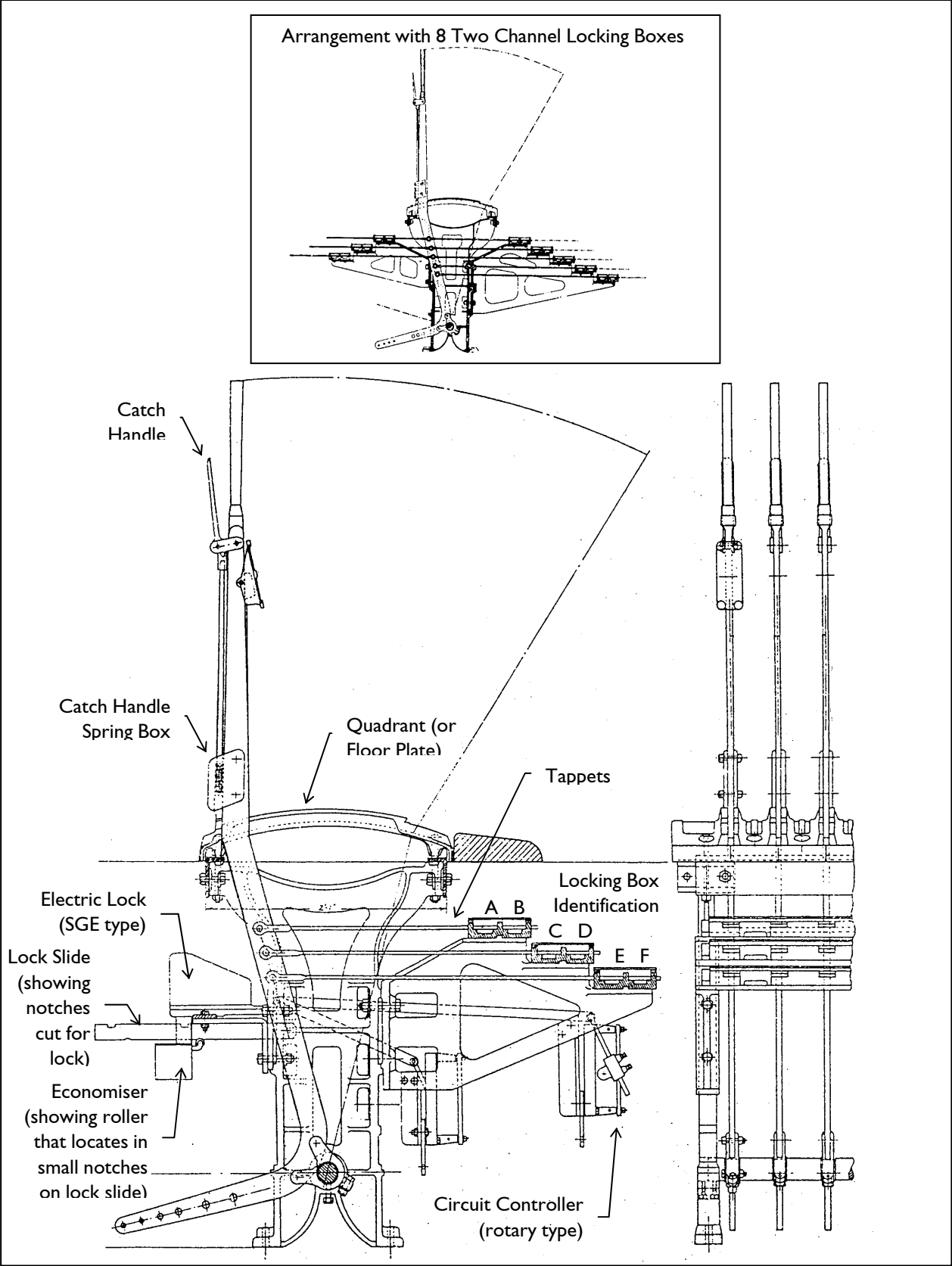


Figure 6 – McKenzie & Holland/Westinghouse No. 16/17 Frame (lever locking)