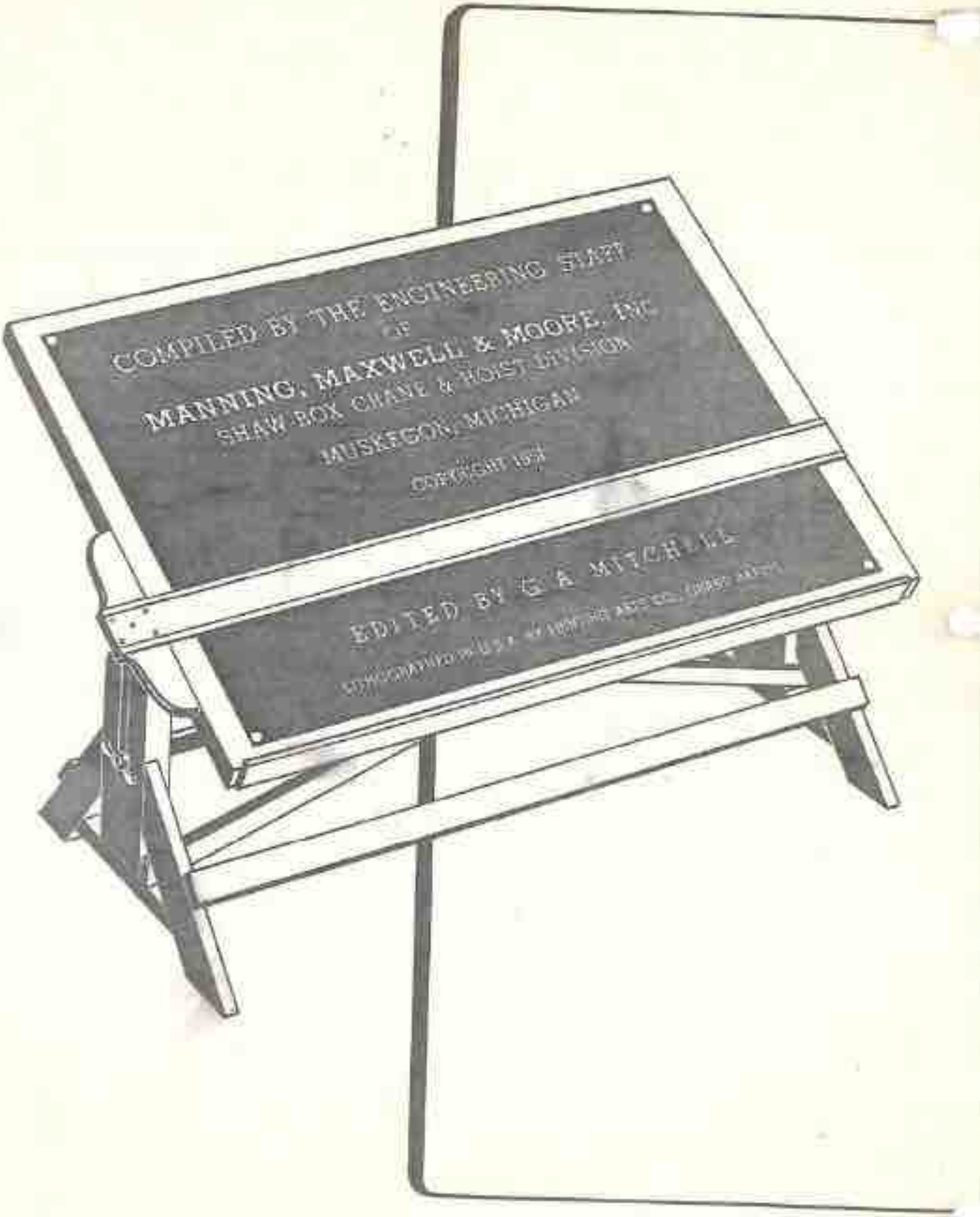
CRANE AND HOIST ENGINEERING

A COMPLETE REFERENCE BOOK ON DESIGN, CONSTRUCTION AND APPLICATION OF CRANES

PUBLISHED AT MUSKEGON, MICHIGAN—1931


COMPILED BY THE ENGINEERING STAFF
OF
MANNING, MAXWELL & MOORE, INC.
SHAW-BOX CRANE & HOIST DIVISION
MUSKEGON, MICHIGAN
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This Book –

compiled by the engineering staff of the Shaw-Box Division of Mannin Maxwell & Moore, Inc., is offered to the engineering profession, schoo and colleges as an authoritative work on crane engineering, des[illegible] application of cranes.

All of the equipment and construction details of all units illustrated a of "Shaw-Box" design and manufacture and are submitted as exhibits the engineering resourcefulness, manufacturing techniques, and attai ments made since 1888, when "Shaw-Box" invented and developed t multi-motored electric traveling crane. So within is sixty-three years progress in crane engineering, from that year to the date of this publicatio

MANNING, MAXWELL &
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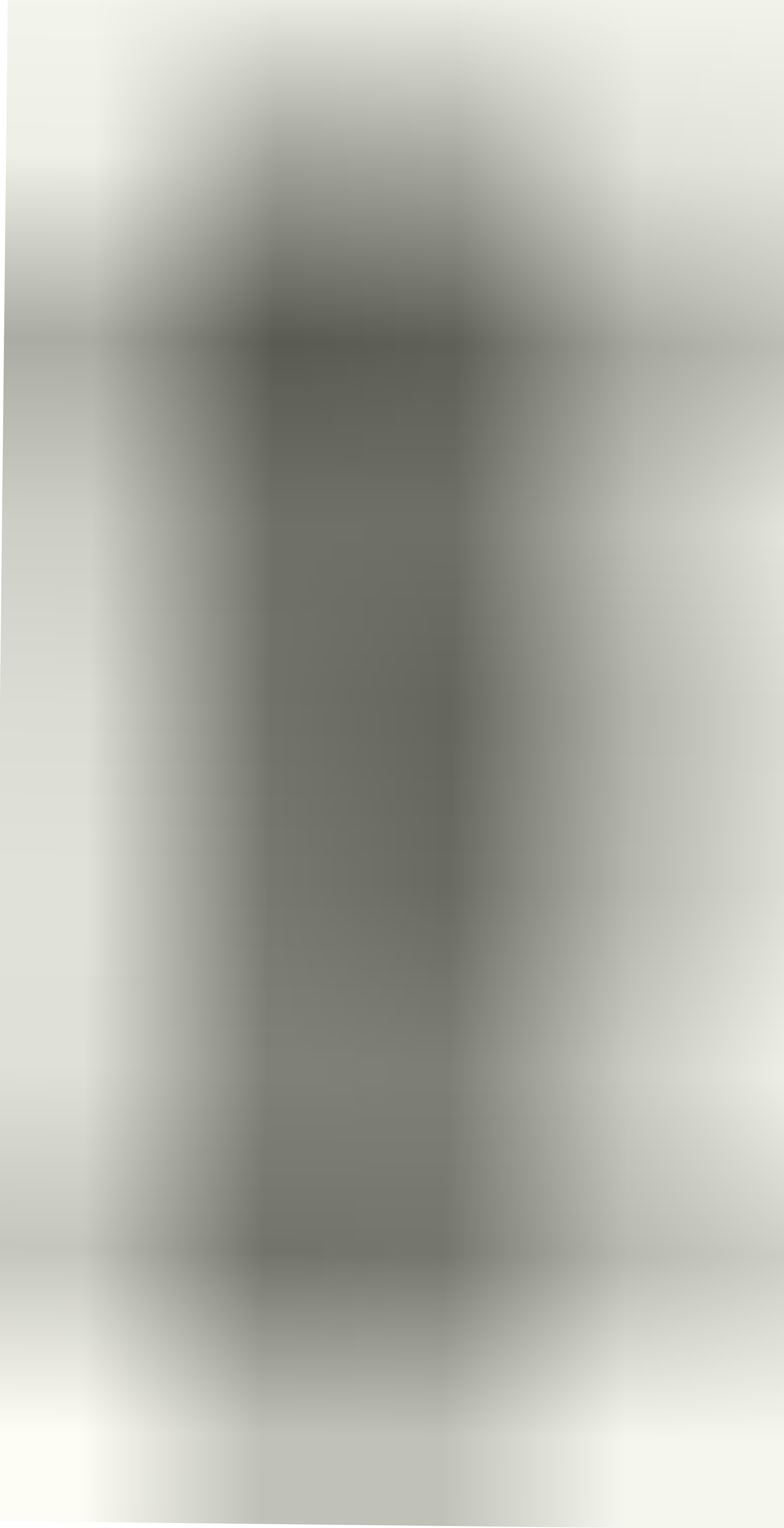
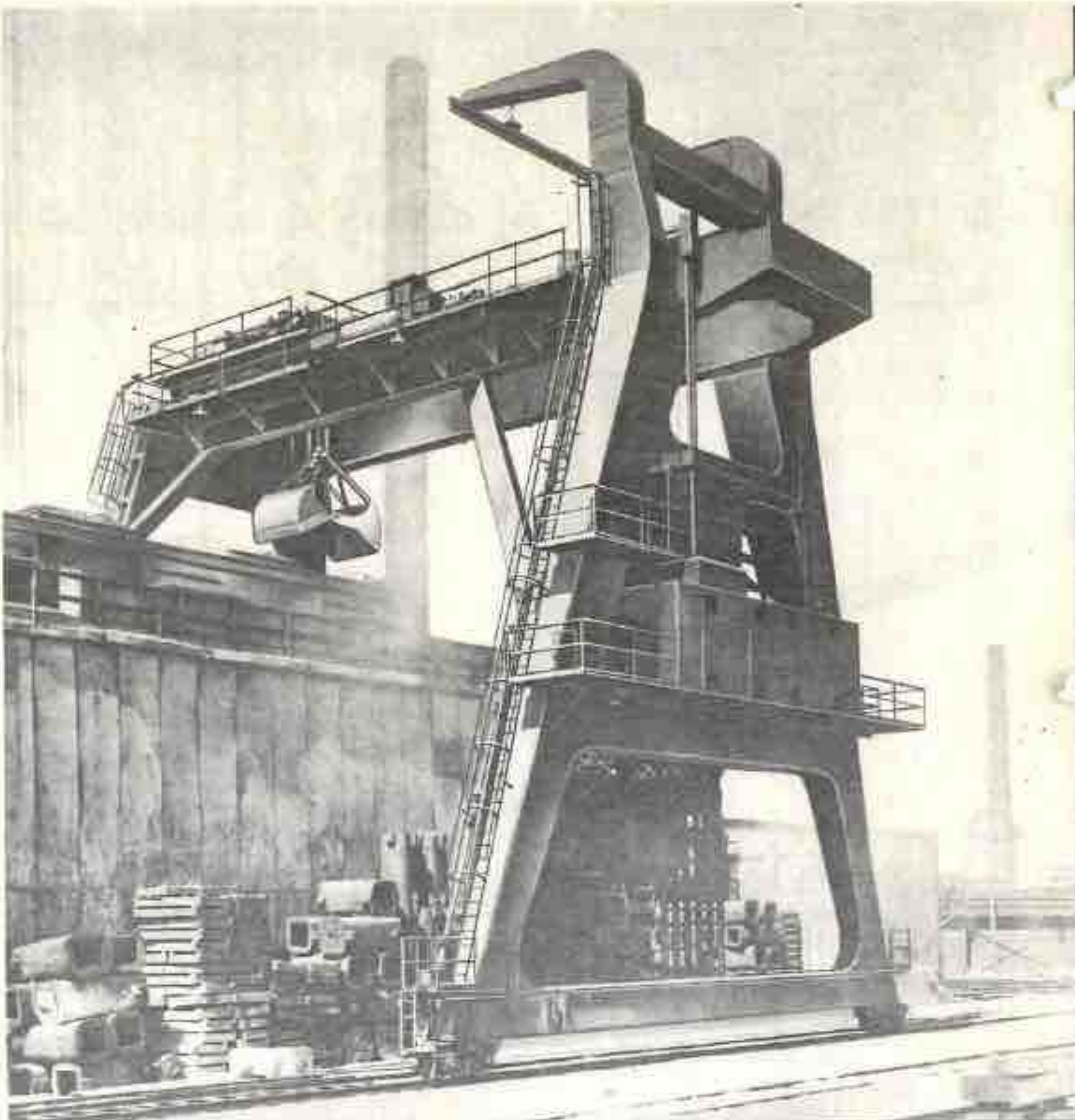
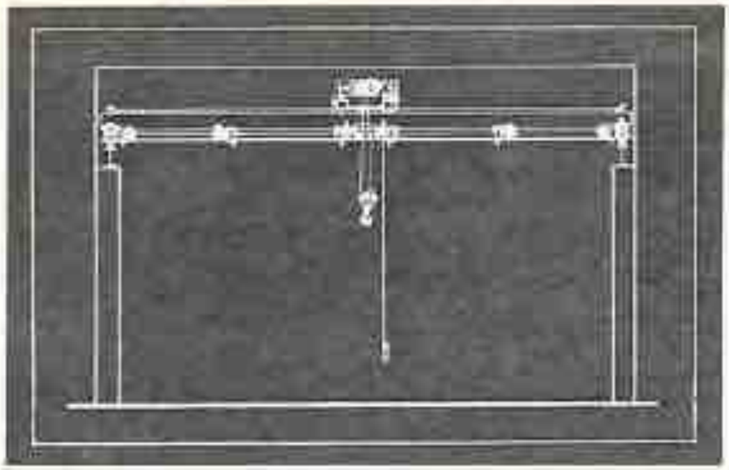
MUSKEGON MICHIGAN

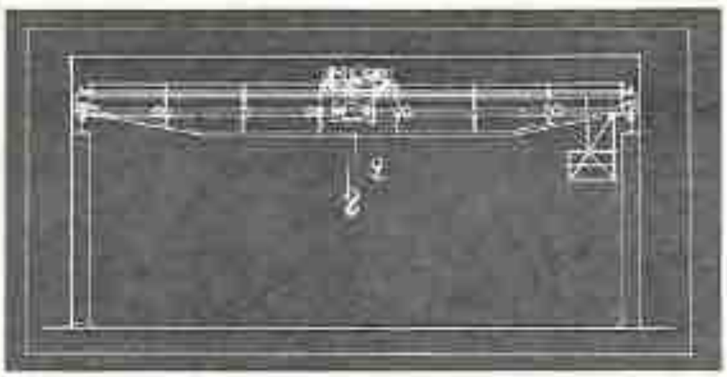




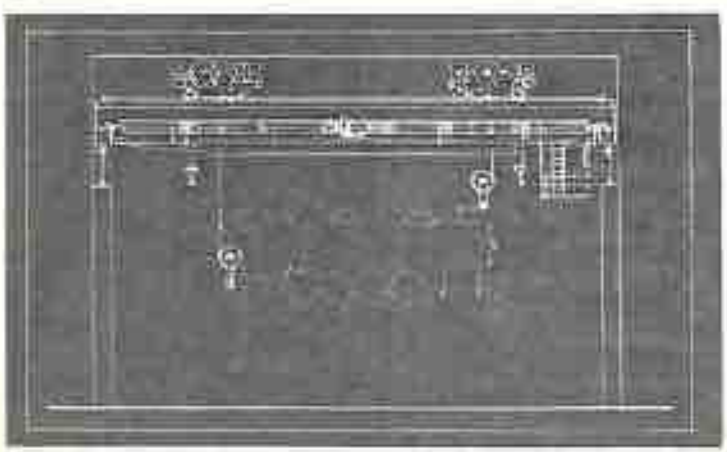
ELECTRIC TRAVELING CRANES



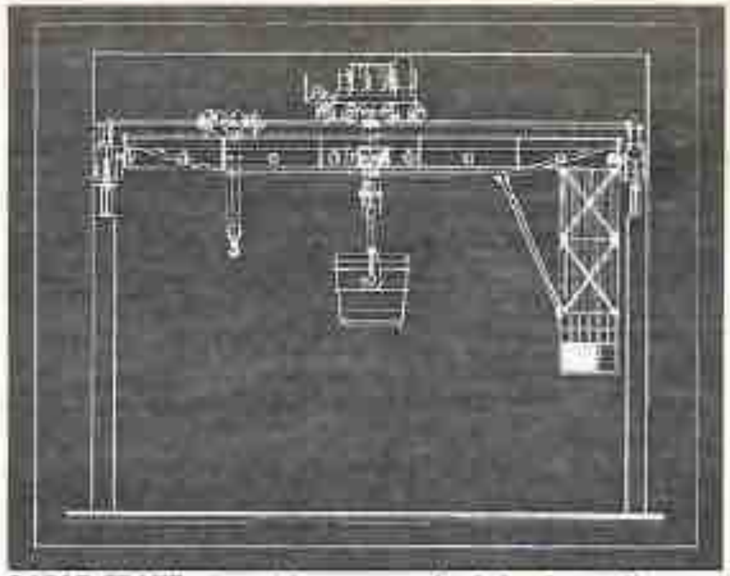
SINGLE TROLLEY SINGLE HOOK CRANE Standard overhead electric traveling crane with single load hook. While illustraticn shows a floor controlled crane, this type usually operated from a cage at one end of bridge. Built in all capacities required by infantry, though usually cranes above 20-ton capacity are equipped with an auxiliary hoist.



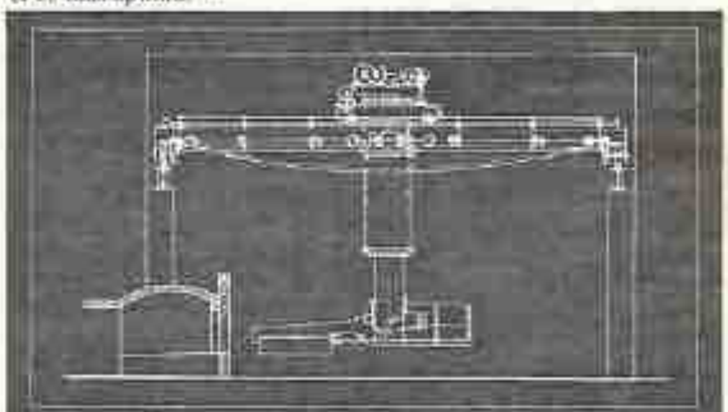
SINGLE TROLLEY WITH AUXILIARY HOIST Standard overhead traveling crane with quick acting auxiliary hoist. Built in all capacities and spans required by industry. This type invariably controlled from an operator's cage. Auxiliary hoist is employed for the rapid handling of light loads.



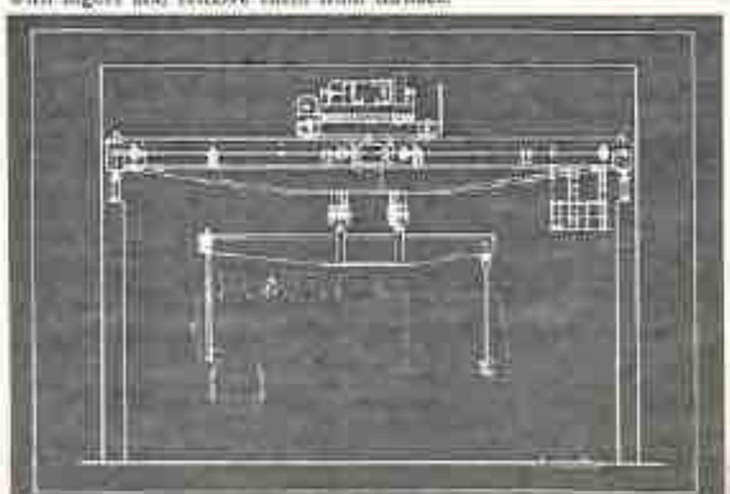
DOUBLE TROLLEY CRANE Standard electric traveling crane with two trolleys. Illustration shows each trolley equipped with auxiliary hoist. Frequently, no auxiliary hoists are employed, and also frequently only one trolley is equipped with an auxiliary hoist. Usually used for handling very heavy or long loads. Built in all capacities and spans required by industry. This type most frequently employed in railroad shops and large power plants.



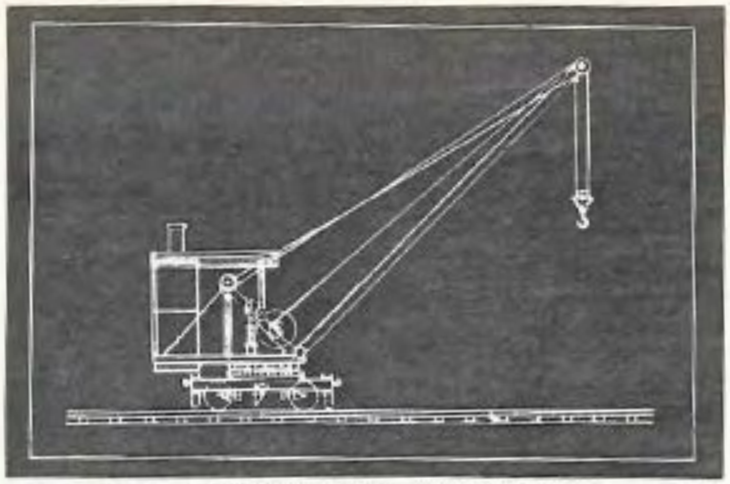
LADLE CRANE A special purpose overhead electric traveling crane developed for handling ladles of hot metal in foundries and steel mills. Equipped with auxiliary trolley for tipping ladle. Usually built in capacities of 50 tons upward.



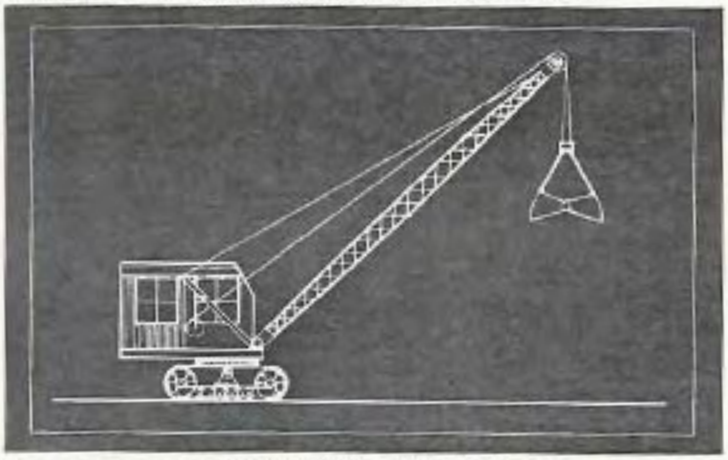
ROTATING CHARGING CRANE In addition to the usual three crane motions, has rotating motion for charging tongs used to charge furnaces with ingots and remove them from furnace.



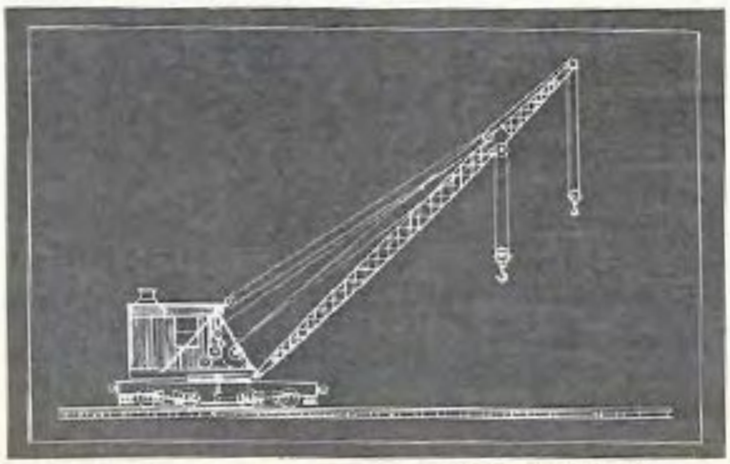
LOCOMOTIVE TURNTABLE CRANE A special purpose crane developed particularly for use in the locomotive repair shops with comparatively narrow bays so that locomotives brought in on a track parallel with the crane bay may be lifted and turned at right angles to the crane bay.



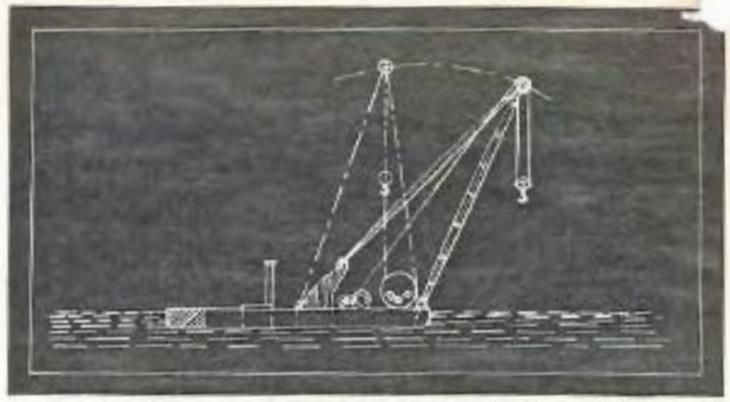
LOCOMOTIVE CRANE ON RAILS A general purpose crane with many uses operating on standard gauge railroad tracks. Crane travels, hoists, swings a complete circle, and boom may be raised or lowered. Power is by either steam engines, electric motors, gasoline engines, or Diesel or Diesel-electric power plants. Usually arranged so that it may handle a clam shell bucket in addition to the usual load hook.



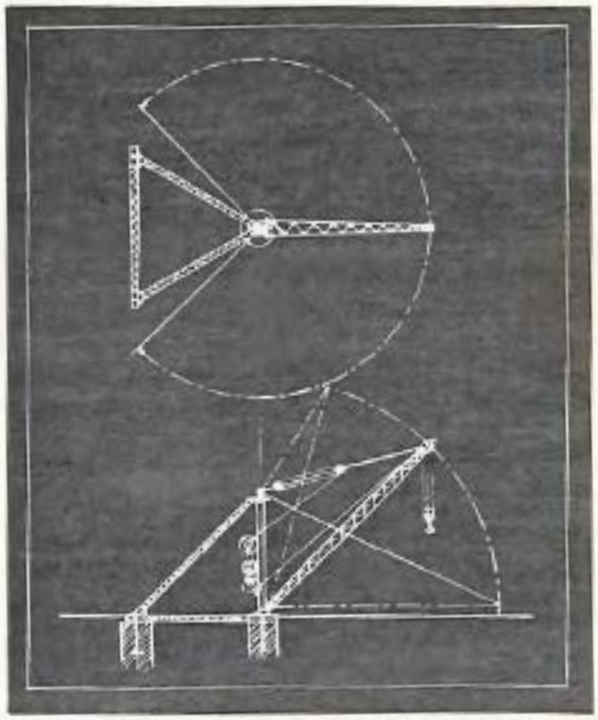
LOCOMOTIVE CRANE WITH CATERPILLAR TREADS A mobile crane with many uses, having same characteristics as crane described above, except that its scope of operation is not confined to tracks inasmuch as it is completely mobile. Generally used for all lifting conditions required in a yard handling bulk materials and for steel erection.



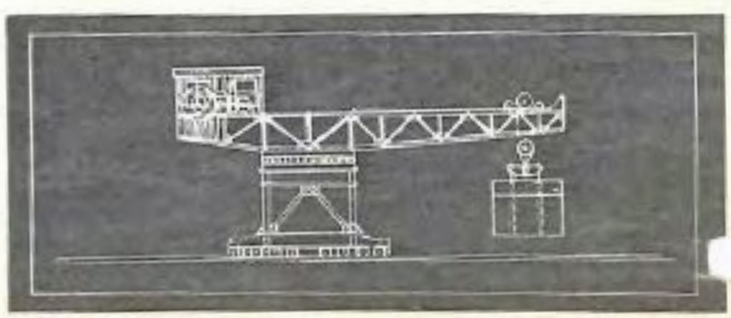
LOCOMOTIVE CRANE ON RAILWAY TRUCKS This type, used almost exclusively on railroads, is for the same usage as two types above, but usually of heavier capacity and mounted on standard railway trucks with equipment so that it may be coupled into the work train.



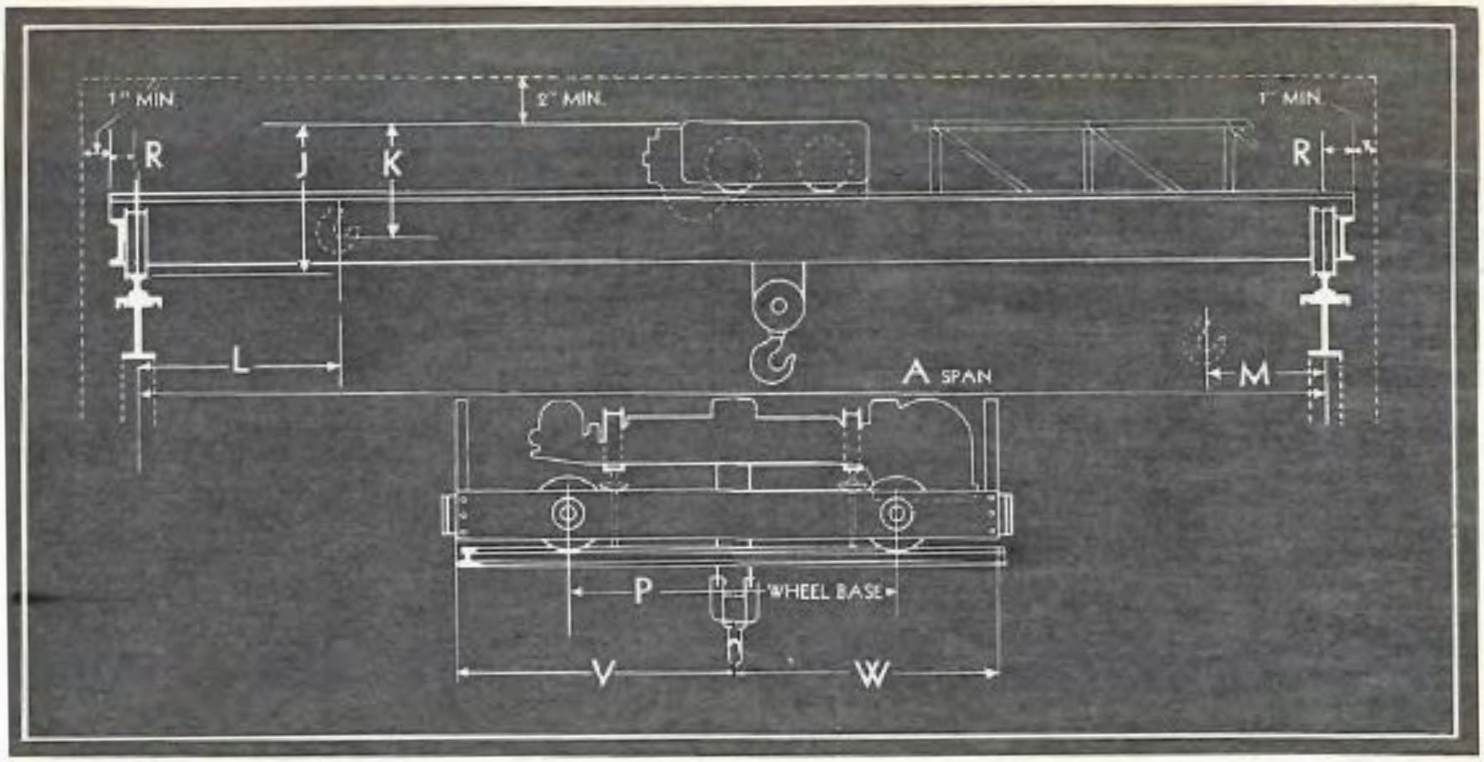
FLOATING CRANE—SHEAR LEG TYPE Used principally in fitting-out basins and harbors to install boilers and heavy machinery during ship construction. This type is the least expensive of floating cranes.



SCOTCH DERRICK A general purpose inexpensive yard crane for general handling. Also used on top of buildings during erection for general lifting.



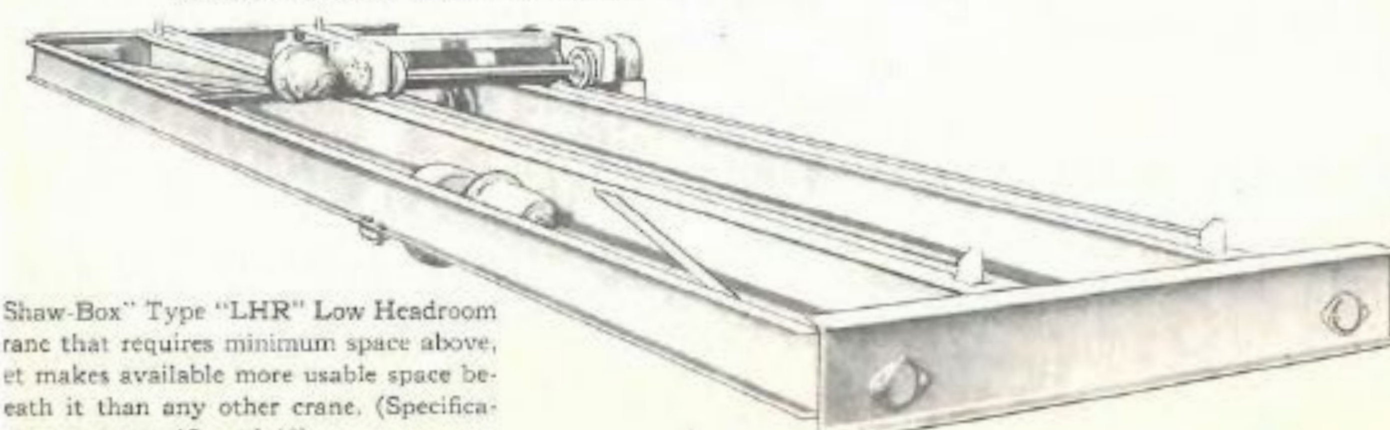
BLOCK SETTING CRANE — TRAVELING ROTATING TYPE A special purpose crane used for building breakwaters and harbors and repair service. Usually built in capacities of 40 to 80 tons.



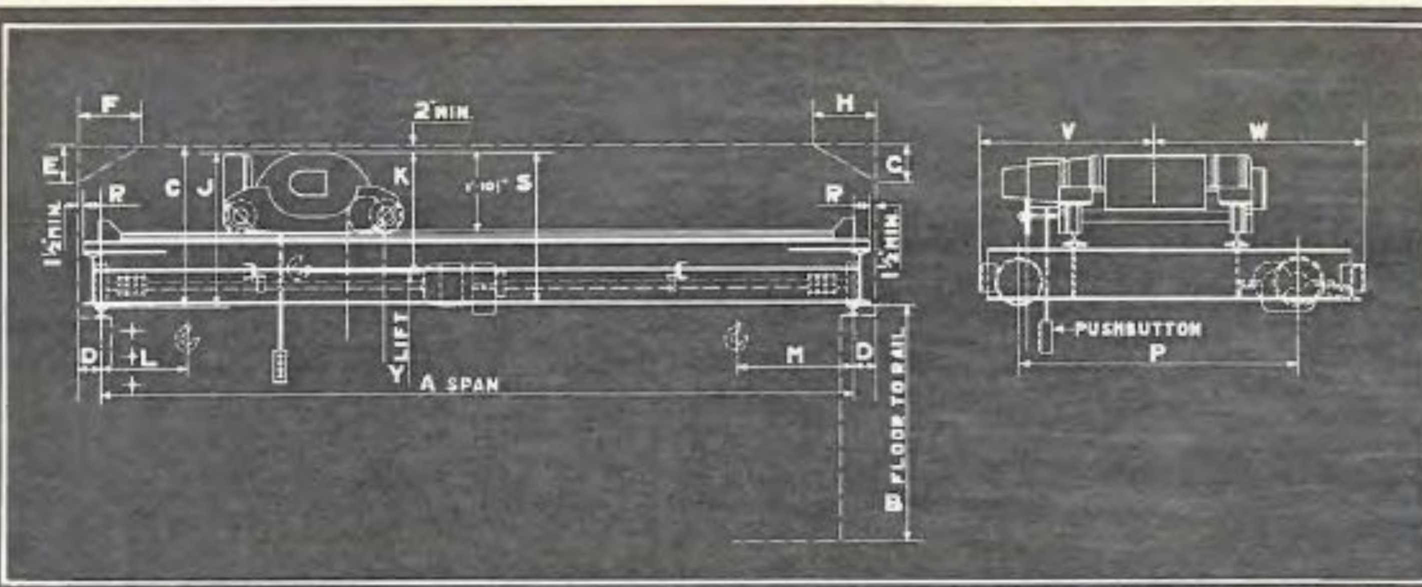
OUTLINE DIMENSIONS OF LOW HEAD ROOM CRANES

Capacity in Tons	A Span to -	J	K	L	M	P	R	S	V	W	Runway Rail	Maximum Wheel Load
1 TON	30' 0"	2' 0⅛"	15"	1' 11½"	1' 8"	6' 3"	4⅝"	1' 11½"	3' 11½"	4' 5"	30#	3,300
	40' 0"	2' 2"	15"	1' 11½"	1' 8"	6' 3"	4⅝"	2' 1½"	3' 11½"	4' 5"	30#	4,400
	45' 0"	2' 4⅜"	15"	1' 7"	1' 6"	6' 3"	4⅝"	2' 3½"	3' 11½"	4' 5"	30#	5,350
	50' 0"	2' 6⅝"	15"	1' 7"	1' 6"	6' 3"	4⅝"	2' 5½"	3' 11½"	4' 5"	30#	5,850
2 TONS	30' 0"	2' 0⅛"	15"	1' 11½"	1' 8"	6' 3"	4⅝"	1' 11½"	3' 11½"	4' 5"	30#	4,450
	40' 0"	2' 2"	15"	1' 11½"	1' 8"	6' 3"	4⅝"	2' 1½"	3' 11½"	4' 5"	30#	5,400
	45' 0"	2' 4⅜"	15"	1' 7"	1' 6"	6' 3"	4⅝"	2' 3½"	3' 11½"	4' 5"	30#	6,310
	50' 0"	2' 6⅝"	15"	1' 7"	1' 6"	6' 3"	4⅝"	2' 5½"	3' 11½"	4' 5"	30#	6,850
3 TONS	30' 0"	2' 0⅛"	15"	1' 11½"	1' 8"	6' 3"	4⅝"	1' 11½"	3' 11½"	4' 5"	30#	5,400
	40' 0"	2' 2"	15"	1' 11½"	1' 8"	6' 3"	4⅝"	2' 1½"	3' 11½"	4' 5"	30#	6,350
	45' 0"	2' 4⅜"	15"	1' 7"	1' 6"	6' 3"	4⅝"	2' 3½"	3' 11½"	4' 5"	30#	7,300
	50' 0"	2' 6⅝"	15"	1' 7"	1' 6"	6' 3"	4⅝"	2' 5½"	3' 11½"	4' 5"	30#	7,800
5 TONS	30' 0"	2' 8⅝"	2' 0"	2' 0"	2' 1"	6' 10"	5"	2' 7⅛"	4' 3½"	5' 1"	30#	8,290
	40' 0"	2' 8⅝"	2' 0"	2' 0"	2' 1"	6' 10"	5"	2' 7⅛"	4' 3½"	5' 1"	30#	9,920
	45' 0"	2' 10⅝"	2' 0"	2' 0"	2' 1"	6' 10"	5"	2' 9⅛"	4' 3½"	5' 1"	30#	10,520
	50' 0"	2' 10⅝"	2' 0"	2' 0"	2' 1"	6' 10"	5"	3' 3⅛"	4' 3½"	5' 1"	30#	11,000

Dimensions show space occupied by crane. Be sure to add for recommended clearances.
Dimensions "L" and "M" are for cranes with controllers on bridge. They are greater when controls are on trolley.



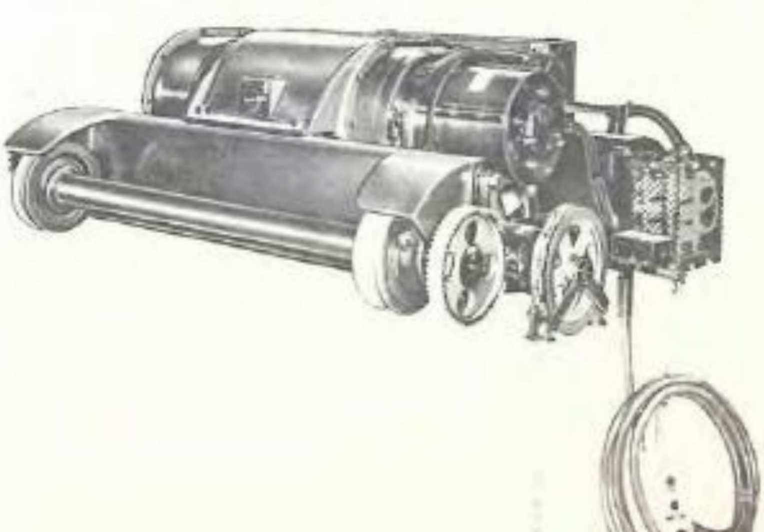
Shaw-Box" Type "LHR" Low Headroom rane that requires minimum space above, et makes available more usable space beeath it than any other crane. (Specificaons on pages 47, and 48)

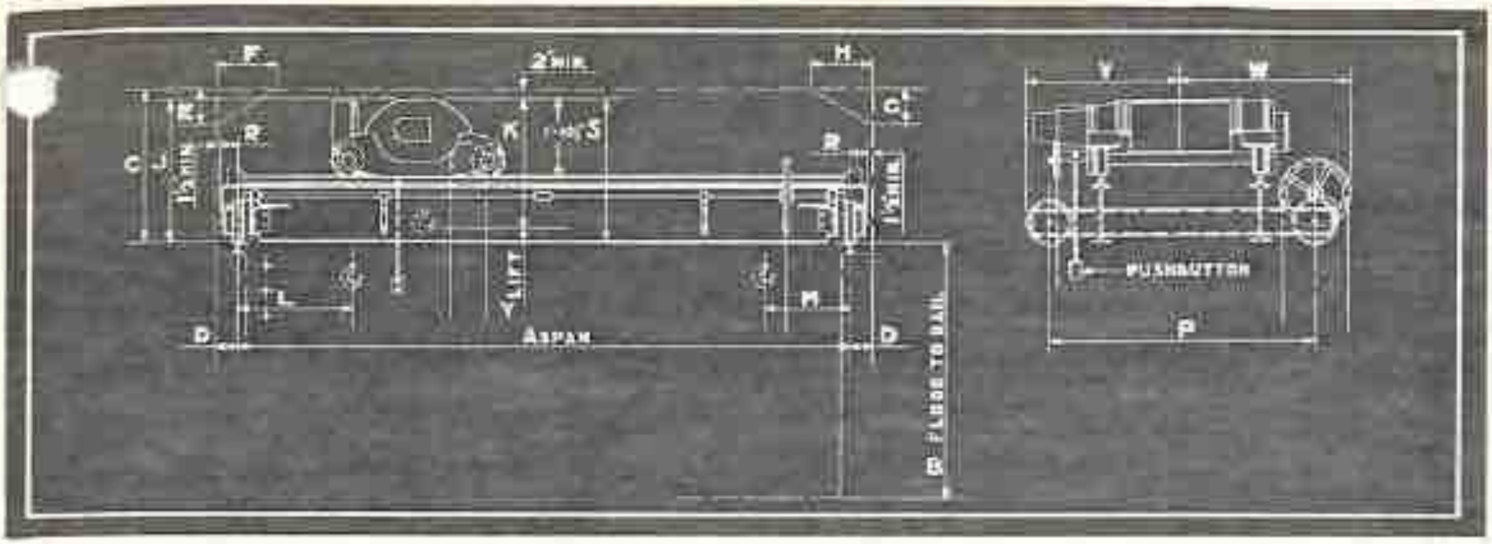


OUTLINE DIMENSIONS MODERATE DUTY SINGLE TROLLEY CRANES—2-MOTOR

Capacity in Tons	Span To	Lift to	J	K	L	M	P	R	S	V	W	Weight Runway Rail	Maximum Wheel Load
5 TONS	30' 0"	40' 0"	3' 5⅝"	2' 10"	2' 4"	1' 11"	6' 10"	5"	3' 4¾"	4' 3½"	5' 1"	30#	7,820
	30' 0"	60' 0"	3' 5⅝"	2' 10"	2' 4"	1' 11"	7' 10"	5"	3' 4¾"	4' 9½"	5' 7"	30#	7,890
	40' 0"	40' 0"	3' 5½"	2' 10"	2' 4"	1' 11"	6' 10"	5"	3' 4⅝"	4' 3½"	5' 1"	30#	9,450
	40' 0"	60' 0"	3' 5½"	2' 10"	2' 4"	1' 11"	7' 10"	5"	3' 4⅝"	4' 9½"	5' 7"	30#	9,520
	45' 0"	40' 0"	3' 7½"	2' 10"	2' 4"	1' 8½"	6' 10"	5"	3' 6⅜"	4' 3½"	5' 1"	30#	10,050
	45' 0"	60' 0"	3' 7½"	2' 10"	2' 4"	1' 8½"	7' 10"	5"	3' 6⅜"	4' 9½"	5' 7"	30#	10,120
	50' 0"	40' 0"	3' 7½"	2' 10"	2' 4"	1' 8½"	6' 10"	5"	4' 0¾"	4' 3½"	5' 1"	30#	10,530
	50' 0"	60' 0"	3' 7½"	2' 10"	2' 4"	1' 8½"	7' 10"	5"	4' 0¾"	4' 9½"	5' 7"	30#	10,600
7½ TONS	30' 0"	20' 0"	3' 8"	2' 10"	1' 11"	2' 4"	6' 2"	5"	3' 8"	5' 8⅜"	5' 6⅝"	30#	10,000
	30' 0"	30' 0"	3' 8"	2' 10"	1' 11"	2' 4"	7' 2"	5"	3' 8"	6' 2⅜"	6' 0⅛"	30#	10,100
	40' 0"	20' 0"	3' 8"	2' 10"	1' 11"	2' 4"	6' 2"	5"	3' 8"	5' 8⅜"	5' 6⅝"	40#	11,650
	40' 0"	30' 0"	3' 8"	2' 10"	1' 11"	2' 4"	7' 2"	5"	3' 8"	6' 2⅜"	6' 0⅛"	40#	11,725
	45' 0"	20' 0"	3' 8"	2' 10"	1' 8½"	2' 4"	6' 2"	5"	3' 10"	5' 8⅜"	5' 6⅝"	40#	12,250
	45' 0"	30' 0"	3' 8"	2' 10"	1' 8½"	2' 4"	7' 2"	5"	3' 10"	6' 2⅜"	6' 0⅛"	40#	12,350
10 TONS	30' 0"	20' 0"	3' 8"	2' 10"	1' 8½"	2' 4"	6' 2"	5"	3' 8"	5' 8⅜"	5' 6⅝"	30#	12,300
	30' 0"	30' 0"	3' 8"	2' 10"	1' 8½"	2' 4"	7' 2"	5"	3' 8"	6' 2⅜"	6' 0⅛"	30#	12,500
	40' 0"	20' 0"	3' 8"	2' 10"	1' 8½"	2' 4"	6' 2"	5"	3' 8"	5' 8⅜"	5' 6⅝"	40#	14,100
	40' 0"	30' 0"	3' 8"	2' 10"	1' 8½"	2' 4"	7' 2"	5"	3' 8"	6' 2⅜"	6' 0⅛"	40#	14,300

"Shaw-Box" 'Load Lifter' Type "DM" crane with electrically operated hoist and bridge travel, and hand operated cross travel. Bridge is the same as that of the three-motor crane described on the previous page. Trolley travel is operated by an endless chain, as illustrated, instead of electrically. (Specifications on pages 49, and 50)

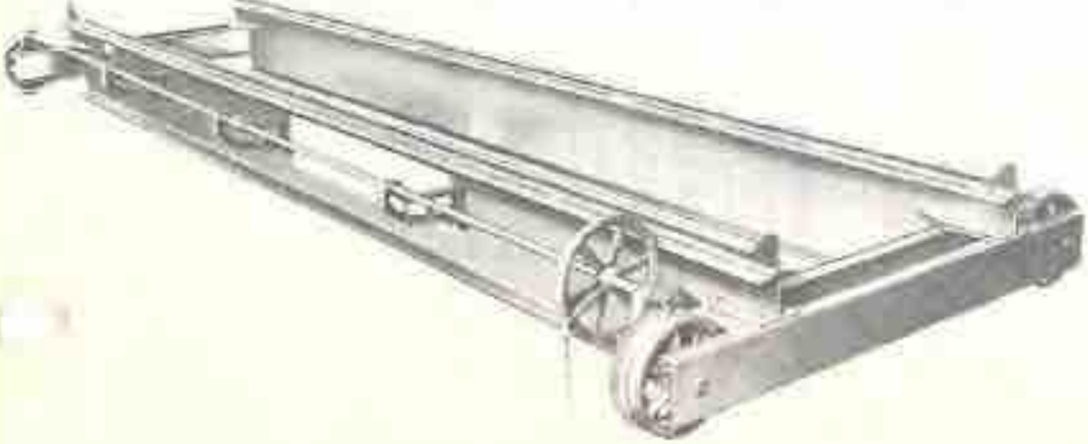




OUTLINE DIMENSIONS MODERATE DUTY SINGLE TROLLEY CRANES—1-MOTOR

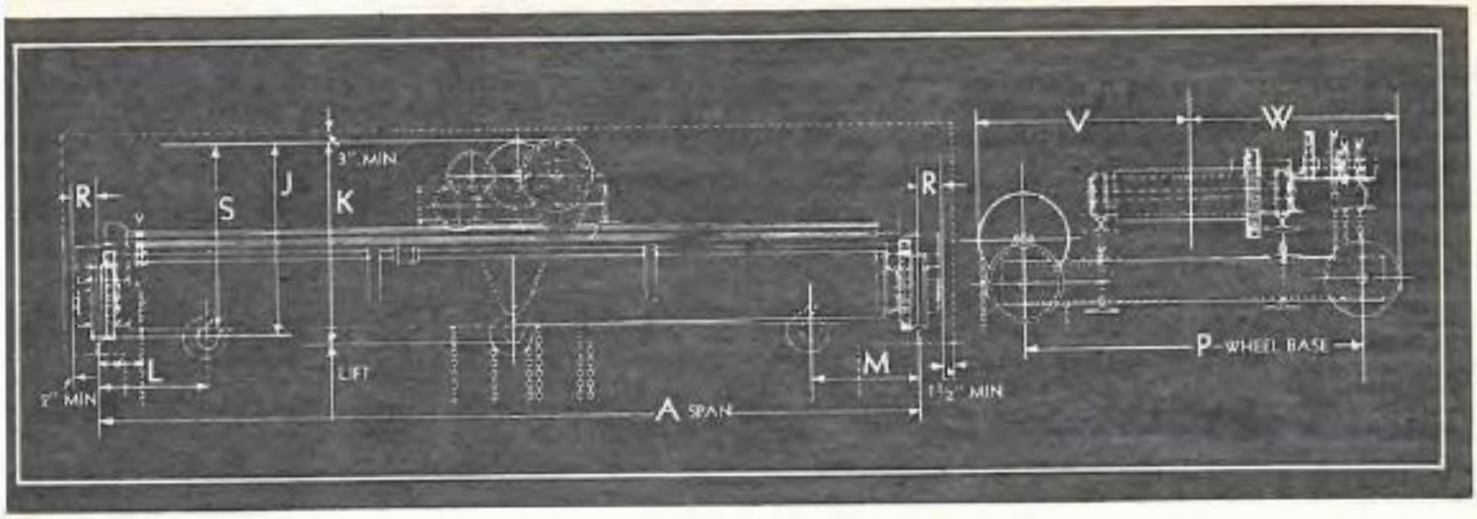
Capacity in Tons	Span To	Lift To	J	K	L	M	P	R	S	V	W	Weight Runway Rail	Maximum Wheel Load in Pounds
5 TONS	20' 0"	40' 0"*	3' 2¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 0¾"	3' 10¾"	4' 0"	25#	7,010
	25' 0"	40' 0"*	3' 4¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 2¾"	3' 10¾"	4' 0"	25#	7,150
	30' 0"	40' 0"*	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 6¾"	3' 10¾"	4' 0"	25#	7,580
	35' 0"	40' 0"*	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 9¾"	3' 10¾"	4' 0"	25#	7,950
	40' 0"	40' 0"*	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 9¾"	3' 10¾"	4' 0"	25#	8,100
	45' 0"	40' 0"*	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	4' 0¾"	3' 10¾"	4' 0"	25#	8,600
	50' 0"	40' 0"*	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	4' 3¾"	3' 10¾"	4' 0"	25#	9,280
	55' 0"	40' 0"*	3' 8¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	4' 3¾"	3' 10¾"	4' 0"	25#	9,550
	60' 0"	40' 0"*	3' 8¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	4' 6¾"	3' 10¾"	4' 0"	25#	10,480
7½ TONS	20' 0"	20' 0"**	3' 4¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 2¾"	3' 10¾"	4' 0"	30#	9,600
	25' 0"	20' 0"**	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 4¾"	3' 10¾"	4' 0"	30#	9,730
	30' 0"	20' 0"**	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 6¾"	3' 10¾"	4' 0"	30#	10,100
	35' 0"	20' 0"**	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 10¾"	3' 10¾"	4' 0"	30#	10,450
	40' 0"	20' 0"**	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	4' 0¾"	3' 10¾"	4' 0"	30#	10,930
	45' 0"	20' 0"**	4' 0"	2' 10"	2' 4"	1' 11"	6' 8"	5"	4' 3¾"	3' 10¾"	4' 0"	30#	11,600
	50' 0"	20' 0"**	4' 0"	2' 10"	2' 4"	1' 11"	6' 8"	5"	4' 3¾"	3' 10¾"	4' 0"	30#	11,850
	55' 0"	20' 0"***	4' 0"	2' 10"	2' 4"	2' 0"	7' 0"	5"	4' 6¾"	4' 2¾"	4' 4½"	30#	12,860
	60' 0"	20' 0"***	4' 0¼"	2' 10"	2' 4"	2' 0"	7' 0"	5"	4' 8¾"	4' 2¾"	4' 4½"	30#	13,100
10 TONS	20' 0"	20' 0"**	3' 5¾"	2' 10"	2' 4"	1' 11"	6' 8"	5"	3' 1¾"	3' 10¾"	4' 0"	30#	12,200
	25' 0"	20' 0"***	3' 9"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	3' 8¾"	4' 2¾"	4' 4½"	30#	12,550
	30' 0"	20' 0"***	3' 9"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	3' 9¾"	4' 2¾"	4' 4½"	30#	12,910
	35' 0"	20' 0"***	3' 9"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	4' 0¾"	4' 2¾"	4' 4½"	30#	13,350
	40' 0"	20' 0"***	3' 9"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	4' 0¾"	4' 2¾"	4' 4½"	30#	13,530
	45' 0"	20' 0"***	4' 0"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	4' 3¾"	4' 2¾"	4' 4½"	30#	14,200
	50' 0"	20' 0"***	4' 0"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	4' 6¾"	4' 2¾"	4' 4½"	30#	15,050
	55' 0"	20' 0"***	4' 0¼"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	4' 8¾"	4' 2¾"	4' 4½"	30#	15,320
	60' 0"	20' 0"***	4' 0¼"	2' 10"	2' 4"	2' 0"	7' 0"	5½"	4' 8¾"	4' 2¾"	4' 4½"	30#	16,100

* Available with lifts to 60' 0". Then Dimensions P, V, and W become: P—7' 0", V—4' 4¾", W—4' 6".
** Available with lifts to 30' 0". Then Dimensions P, V, and W become: P—7' 0", V—4' 8¾", W—4' 6".
*** Available with lifts to 30' 0". Then Dimensions P, V, and W become: P—8' 0", V—4' 8¾", W—4' 10½".



"Shaw-Box" "Load Lifter" crane with electrically operated hoist motion and hand operated bridge and trolley travel motions. Trolley is illustrated on opposite page. The bridge is the same bridge used with the standard "Shaw-Box" Type "BR" double girder hand operated crane. (Specifications on pages 50 and 51)

DOUBLE GIRDER HAND OPERATED CRANES



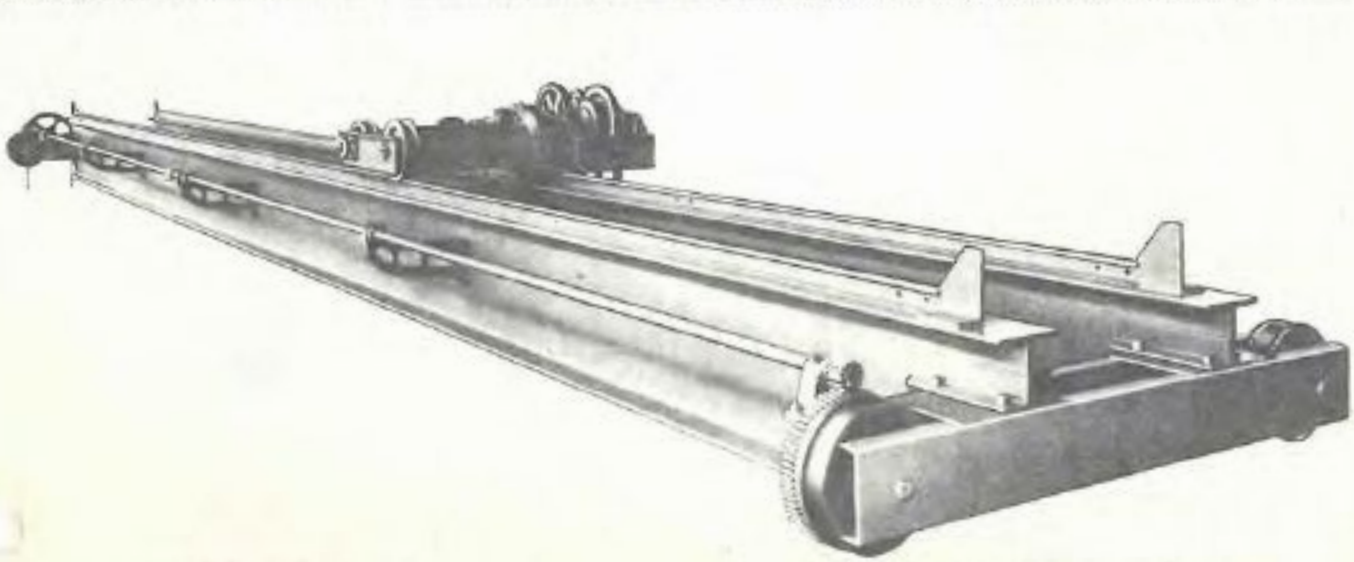
OUTLINE DIMENSIONS

Capacity	A ft	J	K	L	M	P	R	S	V	W	Runway Rail ASCE LBS. Per Yard	Maximum Wheel Load
3 TONS Maximum Lift 28' 0"	15'	2' 8⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	2' 6⅛"	3' 3"	3' 1⅝"	25#	4,160
	20'	2' 8⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	2' 6⅛"	3' 3"	3' 1⅝"	25#	4,250
	25'	2' 8⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	2' 6⅛"	3' 3"	3' 1⅝"	25#	4,350
	30'	2' 10⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	2' 8⅛"	3' 3"	3' 1⅝"	25#	4,540
	35'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	2' 10⅛"	3' 3"	3' 1⅝"	25#	4,750
	40'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 0⅛"	3' 3"	3' 1⅝"	25#	5,090
	45'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 3⅛"	3' 3"	3' 1⅝"	25#	5,540
	50'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 6⅛"	3' 3"	3' 1⅝"	25#	6,160
	55'	3' 2⅜"	3' 1½"	15⅝"	17"	5' 2"	5"	3' 9⅛"	3' 3"	3' 1⅝"	25#	6,890
	60'	3' 2⅜"	3' 1½"	15⅝"	17"	5' 2"	5"	4' 0⅛"	3' 3"	3' 1⅝"	25#	7,700
5 TONS Maximum Lift 28' 0"	15'	2' 8⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	2' 6⅛"	3' 3"	3' 1⅝"	25#	6,160
	20'	2' 8⅝"	3' 1½"	15⅝"	17"	5' 2"	5"	2' 6⅛"	3' 3"	3' 1⅝"	25#	6,250
	25'	2' 10⅝"	3' 1½"	15⅝"	17"	5' 2"	5"	2' 8⅛"	3' 3"	3' 1⅝"	25#	6,430
	30'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	2' 10⅛"	3' 3"	3' 1⅝"	25#	6,630
	35'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 0⅛"	3' 3"	3' 1⅝"	25#	6,930
	40'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 3⅛"	3' 3"	3' 1⅝"	25#	7,350
	45'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 6⅛"	3' 3"	3' 1⅝"	25#	7,930
	50'	2' 11⅝"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 9⅛"	3' 3"	3' 1⅝"	25#	8,620
	55'	3' 2⅜"	3' 1½"	16⅛"	17"	5' 2"	5"	3' 9⅛"	3' 3"	3' 1⅝"	25#	8,890
	60'	3' 2⅜"	3' 1½"	16⅛"	17"	5' 2"	5"	4' 0⅛"	3' 3"	3' 1⅝"	25#	9,700
7½ TONS Maximum Lift 37' 6"	15'	3' 0⅛"	3' 8"	18⅛"	20"	6' 8"	5"	2' 10⅛"	4' 0"	3' 10⅝"	30#	9,070
	20'	3' 2⅛"	3' 8"	18⅛"	20"	6' 8"	5"	3' 0⅛"	4' 0"	3' 10⅝"	30#	9,230
	25'	3' 3"	3' 8"	18⅛"	20"	6' 8"	5"	3' 2⅛"	4' 0"	3' 10⅝"	30#	9,420
	30'	3' 3"	3' 8"	18⅛"	20"	6' 8"	5"	3' 4⅛"	4' 0"	3' 10⅝"	30#	9,710
	35'	3' 3"	3' 8"	18⅛"	20"	6' 8"	5"	3' 7⅛"	4' 0"	3' 10⅝"	30#	10,100
	40'	3' 3"	3' 8"	18⅛"	20"	6' 8"	5"	3' 10⅛"	4' 0"	3' 10⅝"	30#	10,620
	45'	3' 6"	3' 8"	18⅛"	20"	6' 8"	5"	4' 1⅛"	4' 0"	3' 10⅝"	30#	11,270
	50'	3' 6"	3' 8"	18⅛"	20"	6' 8"	5"	4' 1⅛"	4' 0"	3' 10⅝"	30#	11,560
	55'	3' 9⅛"	3' 8"	17⅝"	19½"	7' 0"	5½"	4' 4⅛"	4' 4½"	4' 2⅝"	30#	12,500
	60'	3' 9⅛"	3' 8"	17⅝"	19½"	7' 0"	5½"	4' 1⅝"	4' 4½"	4' 2⅝"	30#	12,840
10 TONS Maximum Lift 37' 6"	15'	3' 2⅛"	3' 8"	18⅛"	20"	6' 8"	5"	3' 0⅛"	4' 0"	3' 10⅝"	30#	11,630
	20'	3' 3"	3' 8"	18⅛"	20"	6' 8"	5"	3' 2⅛"	4' 0"	3' 10⅝"	30#	11,820
	25'	3' 3"	3' 8"	18⅛"	20"	6' 8"	5"	3' 4⅛"	4' 0"	3' 10⅝"	30#	12,070
	30'	3' 6⅛"	3' 8"	17⅝"	19½"	7' 0"	5½"	3' 7⅛"	4' 4½"	4' 2⅝"	30#	12,550
	35'	3' 6⅛"	3' 8"	17⅝"	19½"	7' 0"	5½"	3' 10⅛"	4' 4½"	4' 2⅝"	30#	13,040
	40'	3' 6⅛"	3' 8"	17⅝"	19½"	7' 0"	5½"	3' 10⅛"	4' 4½"	4' 2⅝"	30#	13,240
	45'	3' 9⅛"	3' 8"	17⅝"	19½"	7' 0"	5½"	4' 1⅛"	4' 4½"	4' 2⅝"	30#	14,020
	50'	3' 9⅛"	3' 8"	17⅝"	19½"	7' 0"	5½"	4' 4⅛"	4' 4½"	4' 2⅝"	30#	14,670
	55'	3' 9½"	3' 8"	17⅝"	19½"	7' 0"	5½"	4' 1⅝"	4' 4½"	4' 2⅝"	30#	15,060
	60'	3' 9½"	3' 8"	17⅝"	19½"	7' 0"	5½"	4' 1⅝"	4' 4½"	4' 2⅝"	30#	15,810
15 TONS Maximum Lift 25' 0"	15'	3' 4⅛"	3' 9⅝"	17⅝"	19⅝"	7' 0"	5½"	3' 2⅛"	4' 4½"	4' 2⅝"	40#	16,860
	20'	3' 6⅛"	3' 9⅝"	17⅝"	19⅝"	7' 0"	5½"	3' 4⅛"	4' 4½"	4' 2⅝"	40#	17,100
	25'	3' 6⅛"	3' 9⅝"	17⅝"	19⅝"	7' 0"	5½"	3' 7⅛"	4' 4½"	4' 2⅝"	40#	17,420
	30'	3' 6⅛"	3' 9⅝"	17⅝"	19⅝"	7' 0"	5½"	3' 10⅛"	4' 4½"	4' 2⅝"	40#	17,880
	35'	3' 6⅛"	3' 9⅝"	17⅝"	19⅝"	7' 0"	5½"	3' 10⅛"	4' 4½"	4' 2⅝"	40#	18,100
	40'	3' 9⅛"	3' 9⅝"	17⅝"	19⅝"	7' 0"	5½"	4' 1⅛"	4' 4½"	4' 2⅝"	40#	18,730
	45'	3' 9⅛"	3' 9⅝"	17⅝"	19⅝"	7' 0"	5½"	4' 4⅛"	4' 4½"	4' 2⅝"	40#	19,420
	50'	3' 10½"	3' 9⅝"	16⅝"	18½"	7' 4"	6½"	4' 1⅝"	4' 8"	4' 6⅛"	40#	20,010
	55'	3' 10½"	3' 9⅝"	16⅝"	18½"	7' 4"	6½"	4' 1⅝"	4' 8"	4' 6⅛"	40#	20,770
	60'	3' 10½"	3' 9⅝"	16⅝"	18½"	7' 4"	6½"	4' 4½"	4' 8"	4' 6⅛"	40#	21,700

Capacity	A ft.	J	K	L	N	P	R	S	V	W	Runway Rail ASCE LBS. Per Yard	Maximum Wheel Load
15 TONS Maximum Lift 36' 0"	15'	3' 4½"	3' 9¼"	17¾"	19¼"	8' 0"	5½"	3' 2¼"	4' 11¼"	4' 8¼"	40#	16,935
	20'	3' 6¼"	3' 9¼"	17¾"	19¼"	8' 0"	5½"	3' 4¾"	4' 11¼"	4' 8¼"	40#	17,175
	25'	3' 6¼"	3' 9¼"	17¾"	19¼"	8' 0"	5½"	3' 7¼"	4' 11¼"	4' 8¼"	40#	17,495
	30'	3' 6¼"	3' 9¼"	17¾"	19¼"	8' 0"	5½"	3' 10¼"	4' 11¼"	4' 8¼"	40#	17,955
	35'	3' 6¼"	3' 9¼"	17¾"	19¼"	8' 0"	5½"	3' 10¾"	4' 11¼"	4' 8¼"	40#	18,175
	40'	3' 9¼"	3' 9¼"	17¾"	19¼"	8' 0"	5½"	4' 1½"	4' 11¼"	4' 8¼"	40#	18,755
	45'	3' 9¼"	3' 9¼"	17¾"	19¼"	8' 0"	5½"	4' 4½"	4' 11¼"	4' 8¼"	40#	19,495
	50'	3' 10½"	3' 9¼"	16¾"	18½"	8' 4"	6½"	4' 1½"	5' 2¼"	5' 0¾"	40#	20,145
	55'	3' 10½"	3' 9¼"	16¾"	18½"	8' 4"	6½"	4' 1½"	5' 2¼"	5' 0¾"	40#	20,845
	60'	3' 10½"	3' 9¼"	16¾"	18½"	8' 4"	6½"	4' 4¾"	5' 2¼"	5' 0¾"	40#	21,775
20 TONS Maximum Lift 34' 0"	15'	3' 8¾"	4' 1½"	16"	19"	8' 4"	6½"	3' 4⅝"	5' 2¼"	4' 6¾"	40#	22,580
	20'	3' 8¾"	4' 1½"	16"	19"	8' 4"	6½"	3' 7⅝"	5' 2¼"	4' 6¾"	40#	22,980
	25'	3' 10¾"	4' 1½"	16"	19"	8' 4"	6½"	3' 7⅝"	5' 2¼"	4' 6¾"	40#	23,070
	30'	3' 10¾"	4' 1½"	16"	19"	8' 4"	6½"	3' 10⅝"	5' 2¼"	4' 6¾"	40#	23,540
	35'	3' 10¾"	4' 1½"	16"	19"	8' 4"	6½"	4' 1⅝"	5' 2¼"	4' 6¾"	40#	24,100
	40'	3' 11"	4' 1½"	16"	19"	8' 4"	6½"	4' 4⅝"	5' 2¼"	4' 6¾"	40#	24,700
	45'	3' 11"	4' 1½"	16"	19"	8' 4"	6½"	4' 2½"	5' 2¼"	4' 6¾"	40#	25,150
	50'	3' 11"	4' 1½"	16"	19"	8' 4"	6½"	4' 5½"	5' 2¼"	4' 6¾"	40#	26,300
	55'	4' 2"	4' 1½"	16"	19"	8' 4"	6½"	4' 5½"	5' 2¼"	4' 6¾"	40#	26,710
	60'	4' 2"	4' 1½"	16"	19"	8' 4"	6½"	4' 8½"	5' 2¼"	4' 6¾"	40#	27,400
See Note 15 TONS Maximum Lift 37' 0"	15'	3' 11"	5' 0¾"	2' 7"	2' 5½"	8' 0"	5½"	3' 9½"	4' 11¼"	4' 10¾"	40#	17,970
	20'	4' 1"	5' 0¾"	2' 4"	2' 5½"	8' 0"	5½"	3' 11⅜"	4' 11¼"	4' 10¾"	40#	18,210
	25'	4' 1"	5' 0¾"	2' 4"	2' 5½"	8' 0"	5½"	4' 2⅜"	4' 11¼"	4' 10¾"	40#	18,550
	30'	4' 1"	5' 0¾"	2' 4"	2' 5½"	8' 0"	5½"	4' 5⅜"	4' 11¼"	4' 10¾"	40#	19,010
	35'	4' 4"	5' 0¾"	2' 4"	2' 5½"	8' 0"	5½"	4' 8⅜"	4' 11¼"	4' 10¾"	40#	19,570
	40'	4' 4"	5' 0¾"	2' 4"	2' 5½"	8' 0"	5½"	4' 8⅜"	4' 11¼"	4' 10¾"	40#	19,880
	45'	4' 5½"	5' 0¾"	2' 3"	2' 4½"	8' 4"	6½"	4' 11⅜"	5' 2¼"	5' 0¾"	40#	20,840
	50'	4' 5¼"	5' 0¾"	2' 3"	2' 4½"	8' 4"	6½"	4' 8⅜"	5' 2¼"	5' 0¾"	40#	21,250
	55'	4' 5¼"	5' 0¾"	2' 3"	2' 4½"	8' 4"	6½"	4' 8⅜"	5' 2¼"	5' 0¾"	40#	21,950
	60'	4' 5¼"	5' 0¾"	2' 3"	2' 4½"	8' 4"	6½"	4' 11⅜"	5' 2¼"	5' 0¾"	40#	22,880
See Note 20 TONS Maximum Lift 35' 0"	15'	4' 3½"	5' 2¼"	2' 7½"	2' 4½"	8' 4"	6½"	3' 11⅝"	5' 2¼"	5' 0¾"	40#	23,480
	20'	4' 3½"	5' 2¼"	2' 7½"	2' 4½"	8' 4"	6½"	4' 2⅝"	5' 2¼"	5' 0¾"	40#	23,780
	25'	4' 3½"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	4' 2⅝"	5' 2¼"	5' 0¾"	40#	23,970
	30'	4' 5½"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	4' 5⅝"	5' 2¼"	5' 0¾"	40#	24,440
	35'	4' 5½"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	4' 8⅝"	5' 2¼"	5' 0¾"	40#	25,090
	40'	4' 5½"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	4' 11⅝"	5' 2¼"	5' 0¾"	40#	25,690
	45'	4' 5½"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	4' 8⅝"	5' 2¼"	5' 0¾"	40#	26,050
	50'	4' 5¾"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	4' 11⅝"	5' 2¼"	5' 0¾"	40#	27,800
	55'	4' 8¾"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	4' 11⅝"	5' 2¼"	5' 0¾"	40#	27,610
	60'	4' 8¾"	5' 2¼"	2' 3"	2' 4½"	8' 4"	6½"	5' 2⅝"	5' 2¼"	5' 0¾"	40#	28,300
See Note 25 TONS Maximum Lift 35' 0"	15'	4' 3½"	5' 2¼"	2' 7½"	2' 4½"	9' 10"	6½"	4' 2⅝"	5' 11¼"	5' 9¾"	50#	28,990
	20'	4' 3½"	5' 2¼"	2' 7½"	2' 4½"	9' 10"	6½"	4' 2⅝"	5' 11¼"	5' 9¾"	50#	29,170
	25'	4' 5½"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	4' 5⅝"	5' 11¼"	5' 9¾"	50#	29,590
	30'	4' 8½"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	4' 8⅝"	5' 11¼"	5' 9¾"	50#	30,120
	35'	4' 5½"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	4' 11⅝"	5' 11¼"	5' 9¾"	50#	30,720
	40'	4' 5½"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	4' 11⅝"	5' 11¼"	5' 9¾"	50#	31,050
	45'	4' 5¾"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	4' 11⅝"	5' 11¼"	5' 9¾"	50#	32,170
	50'	4' 5¾"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	4' 11⅝"	5' 11¼"	5' 9¾"	50#	32,590
	55'	4' 8¾"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	5' 2⅝"	5' 11¼"	5' 9¾"	50#	33,250
	60'	4' 8¾"	5' 2¼"	2' 3"	2' 4½"	9' 10"	6½"	5' 5⅝"	5' 11¼"	5' 9¾"	50#	34,760

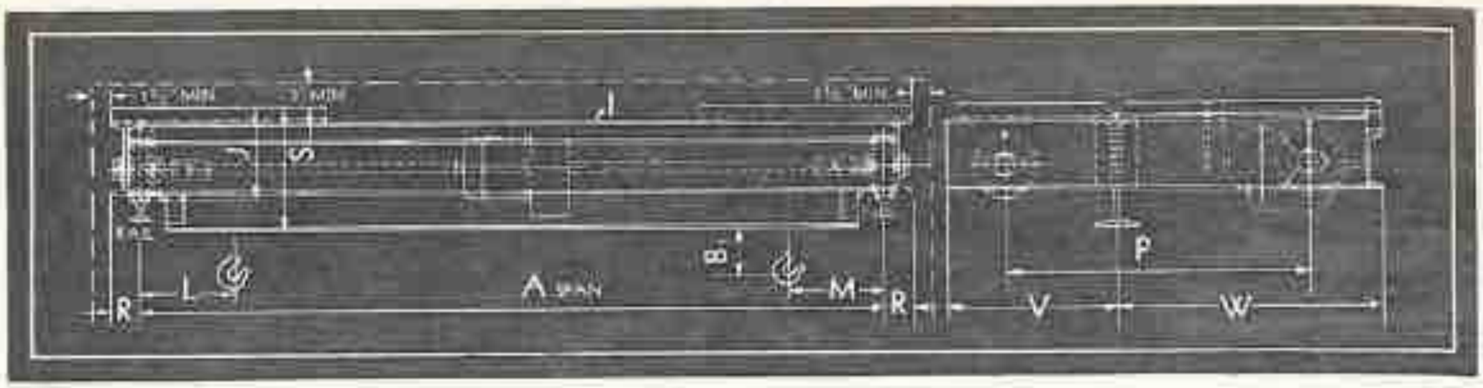
Dimensions are those of the most popular sizes of our standard cranes. Clearances as suggested should be provided. Apply to factory for information on cranes of longer span or heavier capacities than those listed. Clearances may be modified to meet unusual or existing conditions. For heavier capacities refer to factory. Do not use these dimensions for construction purposes — apply to factory for certified dimension prints.

NOTE The winding drums on these cranes are grooved right and left hand and two parts of rope are wound on drum. All other cranes listed have single grooved drums and one part of rope is wound on drum.



"Shaw-Box" Type "BR" Double Girder Hand Operated Traveling Crane. This crane, built in capacities to 50-tons, has wire rope and drum type hoist, two speeds of lifting. It is popular in power plants, pumping stations, crusher plants, etc. (Specifications on pages 50 and 51)

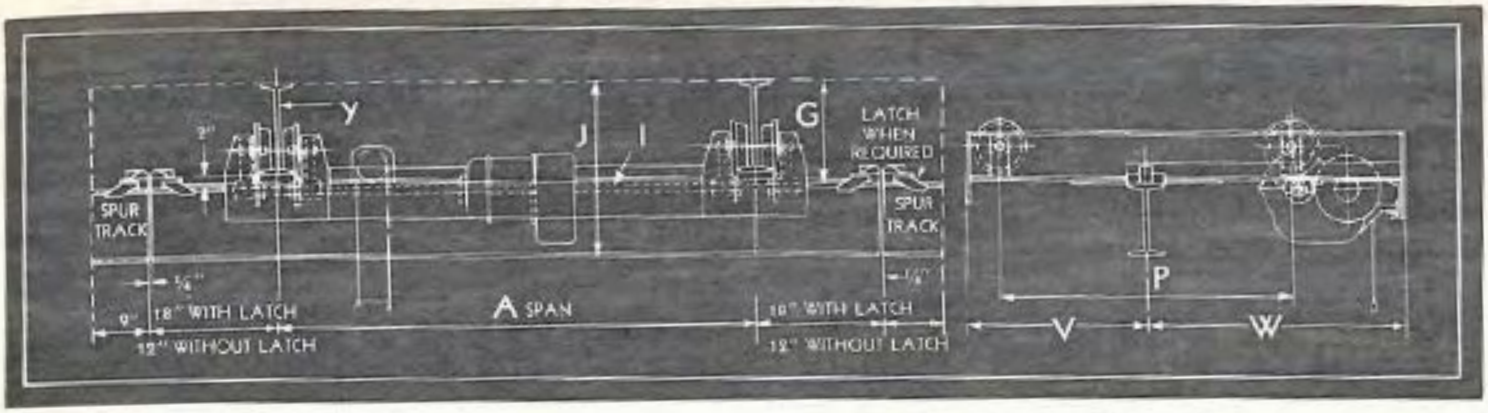
DIMENSIONS SINGLE GIRDER ELECTRIC BRIDGES—Top Running



Capacity in Pounds	A Span ft.	L	S	P	R	V	W	I-BEAM	Size of Runway Rail ASCE per Yard
2,000	15' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	17' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	20' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	22' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	25' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	27' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	30' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	32' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	35' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	37' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	40' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
4,000	15' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	17' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	20' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	22' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	25' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	27' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	30' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	32' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	35' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	37' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	40' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
6,000	15' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	17' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	20' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	22' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	25' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	27' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	30' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	32' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	35' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	37' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	40' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
8,000	15' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	17' 6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	20' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
10,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30
	40' 0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30

"Shaw-Box" Type "SBE" Single Girder Top Running Electrically Operated Bridge. The hoisting units are standard "Shaw-Box" "Load Lifter" hoists. Bridge has direct drive, the wheels being carried on rotating axles and is equipped throughout with radial thrust ball bearings. (Specifications on page 33)

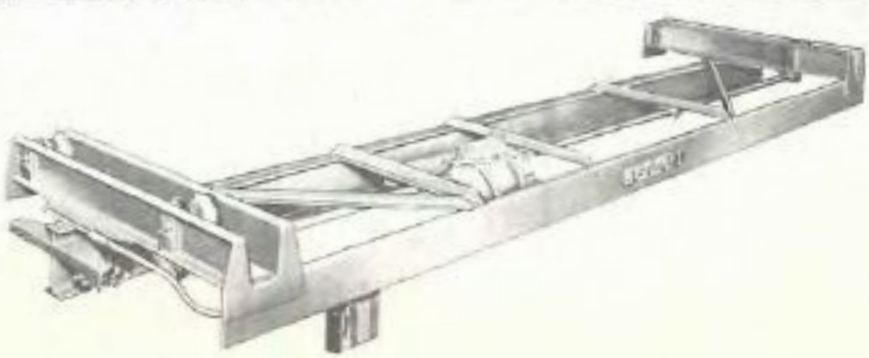
DIMENSIONS SINGLE GIRDER ELECTRIC BRIDGES – Underhung



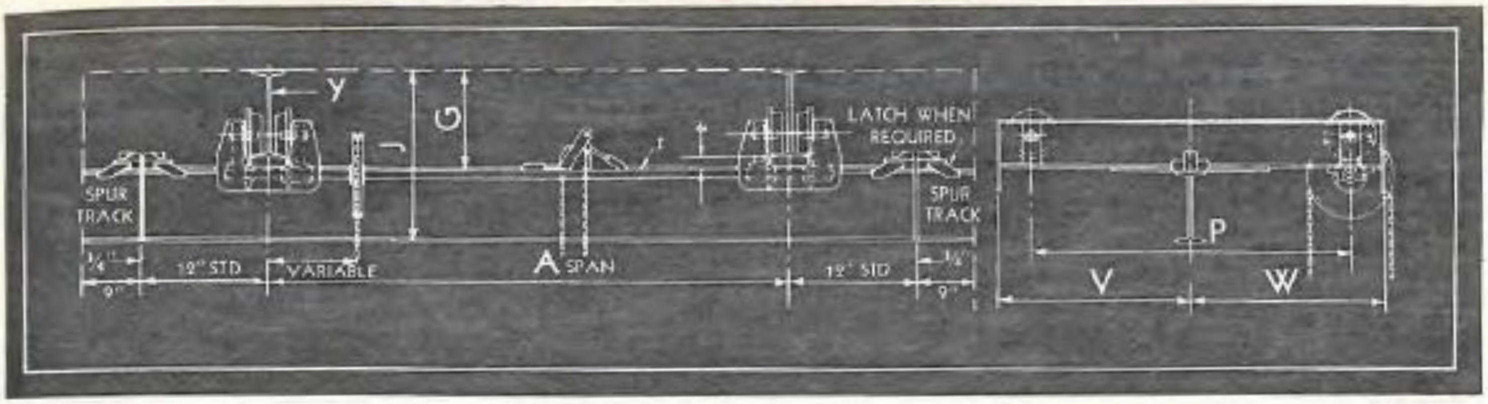
Capacity in Pounds	A Spans ★	★ C	★ G	Z Min.	I	S and T Without Locking Device	S and T With Locking Device	P	V	W
2,000	20' 0"	12"	10"	8"	10"—25.4#	12"	18"	4' 0"	2' 6"	3' 8"
	22' 6"	14"	10"	8"	12"—31.8#	12"	18"	4' 0"	2' 6"	3' 8"
	25' 0"	14"	10"	8"	12"—31.8#	12"	18"	5' 0"	3' 0"	4' 2"
	27' 6"	14"	10"	8"	12"—31.8#	12"	18"	5' 0"	3' 0"	4' 2"
	30' 0"	14"	10"	8"	12"—31.8#	12"	18"	5' 0"	3' 0"	4' 2"
	32' 6"	17"	10"	8"	15"—42.9#	12"	18"	5' 0"	3' 0"	4' 2"
	35' 0"	17"	10"	8"	15"—42.9#	12"	18"	5' 0"	3' 0"	4' 2"
	37' 6"	17"	10"	8"	15"—42.9#	12"	18"	5' 0"	3' 0"	4' 2"
	40' 0"	17"	10"	8"	15"—42.9#	12"	18"	5' 0"	3' 0"	4' 2"
4,000	20' 0"	14"	10"	8"	12"—31.8#	12"	18"	4' 0"	2' 6"	3' 8"
	22' 6"	14"	10"	8"	12"—31.8#	12"	18"	4' 0"	2' 6"	3' 8"
	25' 0"	14"	10"	8"	12"—31.8#	12"	18"	5' 0"	3' 0"	4' 2"
	27' 6"	17"	10"	8"	15"—42.9#	12"	18"	5' 0"	3' 0"	4' 2"
	30' 0"	17"	10"	8"	15"—42.9#	12"	18"	5' 0"	3' 0"	4' 2"
	32' 6"	17"	10"	8"	15"—50#	12"	18"	5' 0"	3' 0"	4' 2"
	35' 0"	17"	10"	8"	15"—50#	12"	18"	5' 0"	3' 0"	4' 2"
	37' 6"	20"	10"	8"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	40' 0"	20"	10"	8"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
6,000	20' 0"	17"	14"	12"	15"—42.9#	12"	18"	4' 0"	2' 6"	3' 8"
	22' 6"	17"	14"	12"	15"—42.9#	12"	18"	4' 0"	2' 6"	3' 8"
	25' 0"	17"	14"	12"	15"—42.9#	12"	18"	5' 0"	3' 0"	4' 2"
	27' 6"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	30' 0"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	32' 6"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	35' 0"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
	37' 6"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
	40' 0"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
8,000	20' 0"	17"	14"	12"	15"—42.9#	12"	18"	4' 0"	2' 6"	3' 8"
	22' 6"	20"	14"	12"	18"—54.7#	12"	18"	4' 0"	2' 6"	3' 8"
	25' 0"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	27' 6"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	30' 0"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	32' 6"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
	35' 0"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
	37' 6"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
	40' 0"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
10,000	20' 0"	17"	14"	12"	15"—42.9#	12"	18"	4' 0"	2' 6"	3' 8"
	22' 6"	20"	14"	12"	18"—54.7#	12"	18"	4' 0"	2' 6"	3' 8"
	25' 0"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	27' 6"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	30' 0"	20"	14"	12"	18"—54.7#	12"	18"	5' 0"	3' 0"	4' 2"
	32' 6"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
	35' 0"	22"	14"	12"	20"—65.4#	12"	18"	5' 0"	3' 0"	4' 2"
	37' 6"	2' 2"	14"	12"	24"—79.9#	12"	18"	5' 0"	3' 0"	4' 2"
	40' 0"	2' 2"	14"	12"	24"—79.9#	12"	18"	5' 0"	3' 0"	4' 2"

★ "C" and "G" Based on Minimum Size Runway Beams.

"Shaw-Box" Type "E-SUH" Single Girder Underhung Crane Bridge Hoisting Unit is "Shaw-Box" 'Load Lifter' hoist. Bridge drive machinery is a self-contained, speed reducer unit with motor and brake, driving a cross shaft which [illegible]ared to two driving wheels in each end truck. (Specifications on page 55)

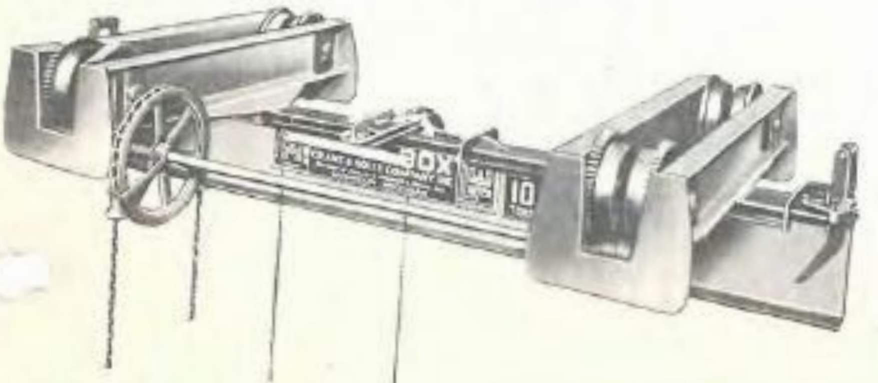


DIMENSIONS SINGLE GIRDER HAND GEARED BRIDGES–
Underhung and Transfer Type



Capacity in Pounds	A Span	C	† G	I Beam	I Channel	P	* S	* T	V	W	† Y Min
2,000	15' 0"	18"	10"	8"—18.4#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	17' 6"	20"	10"	10"—25.4#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	20' 0"	20"	10"	10"—25.4#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	22' 6"	22"	10"	12"—31.8#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	25' 0"	22"	10"	12"—31.8#	....	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	27' 6"	22"	9⅝"	12"—31.8#	7"— 9.8#	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	30' 0"	22"	9⅝"	12"—31.8#	7"— 9.8#	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	35' 0"	22"	9⅝"	12"—31.8#	9"—13.4#	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
4,000	15' 0"	20"	10"	10"—25.4#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	17' 6"	22"	10"	12"—31.8#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	20' 0"	22"	10"	12"—31.8#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	22' 6"	2' 1"	10"	15"—42.9#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	25' 0"	2' 1"	10"	15"—42.9#	....	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	27' 6"	2' 1"	10"	15"—50#	....	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	30' 0"	2' 1"	9⅝"	15"—42.9#	9"—13.4#	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	35' 0"	2' 1"	9⅝"	15"—42.9#	9"—13.4#	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
6,000	15' 0"	22"	10"	12"—31.8#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	17' 6"	2' 1"	10"	15"—42.9#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	20' 0"	2' 1"	10"	15"—42.9#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	22' 6"	2' 1"	10"	15"—50#	....	4' 0"	12"	12"	2' 4 11/16"	2' 5⅝"	8"
	25' 0"	2' 4"	10"	18"—54.7#	....	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	27' 6"	2' 4"	10"	18"—54.7#	....	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	30' 0"	2' 1"	9⅝"	15"—42.9#	9"—13.4#	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
	35' 0"	2' 1"	9⅝"	15"—42.9#	10"—15.3#	5' 0"	12"	12"	2' 10 11/16"	2' 11⅝"	8"
8,000	15' 0"	2' 0"	12"	12"—31.8#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	17' 6"	2' 3"	12"	15"—42.9#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	20' 0"	2' 3"	12"	15"—42.9#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	22' 6"	2' 6"	12"	18"—54.7#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	25' 0"	2' 6"	12"	18"—54.7#	....	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"
	27' 6"	2' 8"	12"	20"—65.4#	....	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"
	30' 0"	2' 6"	11⅝"	18"—54.7#	10"—15.3#	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"
	35' 0"	2' 6"	11 11/16"	18"—54.7#	12"—20.7#	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"
10,000	15' 0"	2' 3"	12"	15"—42.9#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	17' 6"	2' 3"	12"	15"—42.9#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	20' 0"	2' 6"	12"	18"—54.7#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	22' 6"	2' 6"	12"	18"—54.7#	....	4' 0"	12"	12"	2' 5⅝"	2' 5⅝"	10"
	25' 0"	2' 8"	12"	20"—65.4#	....	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"
	27' 6"	2' 8"	12"	20"—65.4#	....	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"
	30' 0"	2' 6"	11⅝"	18"—54.7#	10"—15.3#	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"
	35' 0"	2' 6"	11 11/16"	18"—54.7#	12"—20.7#	5' 0"	12"	12"	2' 11⅝"	2' 11⅝"	10"

* Dimensions "S" and "T" are minimum required for standard bridge. If locking device and baffles are to be used to engage spur tracks, these dimensions become 18" minimum.
† Dimensions "G" and "Y" are based on minimum size runway beam. When the girder is an I-beam and channel, the beam is reinforced by an inverted channel welded to its top flange.
NOTE: Capacity of these bridges provide for use of electric hoist.



"Shaw-Box" Type "H-SUH" Single Girder Hand Geared Underhung Bridge. A "Shaw-Box" 'Load Lifter' electric hoist or chain block is used with this bridge. It is available either as a regular crane bridge or equipped with locking device and baffles as illustrated when it is used as a transfer bridge. (Specifications on page 56)

Below is listed the minimum information that should be submitted to a crane builder to obtain proposals cage or floor controlled electric traveling cranes for industrial or rapid handling service. If all of this infor- ation is submitted to the crane builder as part of the specifications to cover the type of crane desired, it will rmit the crane builder to determine and offer the best and most economical equipment against the inquiry.

FOR ELECTRIC TRAVELING CRANES, THREE OR MORE MOTORS, FOR INDUSTRIAL SERVICE

Capacity, in tons of 2000 pounds, of:

(a) Main hoist, or each trolley of a two trolley crane.

(b) Auxiliary hoist, if required.

(c) If two trolleys are desired, give spacing between trolleys when capacity load is to be handled.

(d) If it is desired to have two or more hooks operating simultaneously, or independently on the one trolley, give:
1. Spacing between hooks.
2. Relationship of hooks to bridge girders (parallel with or at right angles to)

If crane runway has been located, or is in place give:

(a) Span, center to center of runway rails.

(b) Size of runway rails.

(c) Distance from top of runway rail to the lowest obstruction that the crane must clear.

(d) Distance from center of runway rails to the nearest obstruction that the ends of the crane must clear.

(e) Height of hook lift above floor, or ground level necessary.

(f) Height of any obstruction, above floor, that the crane bridge must clear.

(g) If hook must descend below the floor or ground level, give distance.

If crane runway has not been located, give:

(a) Distance between building walls or columns so that span may be determined.

(b) Distance from floor to ceiling, or lowest overhead obstruction that the crane must clear.

(c) Height of any obstruction, above floor, that crane bridge must clear.

(d) Height of hook lift above floor or ground level necessary.

(e) If hook must descend below the floor or ground level, give distance.

4 Characteristics of electric current available.

(a) If direct current, give voltage.

(b) If alternating current, give voltage, phase, and cycles.

5 If there is any preference for make of motors or controllers, give preference.

6 State whether crane is to be controlled from:

(a) Operator's cage. (Give preferred location, whether on end or center of bridge, or on trolley).

(b) Floor by pendent cords. (Give preferred location).

(c) Floor by push buttons. (Give preferred location).

7 Advise whether there is a preference for Roller Bearings or Bronze Bearings throughout the crane.

8 List any special features or accessories desired.

9 Advise if crane is for indoor or outside service.

10 Outline the work the crane is required to perform so that service classification may be determined. If any unusual requirements exist, describe them in detail.

• • •

For Bucket Operating, Magnet Handling, or other Rapid Handling or Continuous service, give the same information as above, plus:

(a) Kind, weight, and amount of material to be handled in a given period, per hour and day, month and year.

(b) Outline operating cycle.

(c) Give size, weight and make of bucket, magnet, or any other load handling device.

INGLE GIRDER BRIDGES, ELECTRICALLY AND HAND OPERATED

TOP RUNNING

Capacity in tons of 2000 pounds. State if it is desired to handle load with one or two hoists. If with two, give distance they will be apart when handling capacity loads.

If crane runway has been located, or is in place, give:

(a) Span, center to center of runway rails.

(b) Size of runway rails.

(c) Distance from top of runway rails to lowest overhead obstruction that crane must clear.

(d) Distance from center of runway rails to nearest obstruction that ends of crane must clear.

(e) Height of hook lift necessary above floor.

(f) If hook is to descend below the floor line, give distance.

If crane runway has not been located, give:

a) Distance between building walls, or columns, so that span may be determined.

b) Distance from floor to ceiling or to lowest overhead obstruction.

c) Height of any obstruction, above floor, that crane bridge must clear.

d) Height of hook lift necessary above floor.

e) If hook is to descend below the floor line, give distance.

Advise whether hoist and trolley is to be included.

State whether bridge movement is to be by:

a) Pushing on load.

b) Manually by pulling on endless chain.

c) Electric motor. (If motor, give characteristics of electric current available. For D.C. give voltage: for A.C. give phase, cycles ,and voltage.)

UNDERHUNG

1 Capacity in tons of 2000 pounds. State if load is to be handled with one or two hoists. If with two, give distance they will be apart when handling capacity loads.

2 Span, center to center of runway tracks.

3 Size and section of track. If I-beams of similar tracks give:

(a) Size of beam.

(b) Width of flange.

(c) Clear space between top of track and any bolt heads, rivet heads, or clamps around top flange to support track.

4 Distance beyond centerline of each track that ends of crane bridge should project.

5 If crane is to be used as a transfer crane, advise whether locking device and baffles are required one end or both; and, the number of latches for ends of engaging spur tracks.

6 State whether hoist and trolley is to be included.

7 State whether bridge movement is to be by:

(a) Pushing on load.

(b) Manually by pulling on endless chain.

(c) Electric motor. (If motor, give characteristics of electric current available. For D.C. give voltage; for A.C. give phase, cycles, and voltage.)

8 If crane is to be electrically operated state:

(a) Which motions are to be electrically operated.

(b) Whether bridge controller is to be mounted on the bridge, or on the hoist.

F(Brake. A shoe type hydraulically operated brake controlled from a foot pedal in the operator's cage having a braking capacity in either direction equal to the full load torque of the bridge motor, shall be mounted on the bridge motor pinion shaft. Brake wheel shall be "Cannonite" or equal metal. Brake shall be of such design that the motor armature may be removed without dismantling the brake.

Cage and Platform. The operator's cage shall be of (insert open type for indoor service, enclosed type for outdoor service). It shall be of ample size to contain controllers, crane switchboard, and the accessories required for operating the crane. It shall be located (insert either end or center) of the crane. The cage shall be built from heavy steel angles and plates and shall be attached and braced to the bridge girder in such manner that it will not weave or sway. A ladder shall be provided from the cage to the platform. A warning gong of the foot operated type shall be mounted in the cage.

The platform shall extend the full length of the crane bridge on the drive girder side rigidly and substantially supported from the girder. The platform shall be made of checkered steel plate, and shall be fitted close to the girder. There shall be a toe board six inches high on the outside edge of the platform. The hand rail shall be 42 inches high with intermediate rail, and shall be made from steel angles.

TROLLEY

Frame. The trolley frame shall be built up from heavy steel plates, angles, and channels adequately braced to resist vertical, lateral and torsional strains, welded together to form a rigid one-piece frame. Welded to the frame shall be the steel bearings for the wheel axles. Welded to the top of the frame shall be a heavy deck plate with machined pads welded thereto to receive the hoisting and trolley travel mechanism and the load girt to carry the equalizer sheaves. Load girt shall be applied in such a manner that deflections are absorbed by the load girt only and not transmitted to any of the operating mechanisms. On the bottom of the trolley frame, on each side, shall be a double end spring bumper to engage stops at each end of the bridge.

Hoisting Machinery. The hoisting machinery shall consist of an electric motor driving by means of spur gear reductions, a winding drum and an automatic mechanical load brake. Gears in the gear reductions shall be mounted on short shafts and supported between bearings adjacent to their hubs. Drum gear shall be pressed on and keyed to the hub of the winding drum. All gears shall be encased in substantial oil tight housings split in a horizontal plane, and shall be readily accessible. The diameter of the drum shall be not less than twenty-four times the diameter of the hoisting rope. It [illegible] l be grooved right and left hand to receive the full run of hoisting cable without overlapping.

(If auxiliary hoist is required, specifications for auxiliary hoist are the same as for main hoist.)

Hoist Motor Brake. Mounted on the same base as the hoist motor shall be an electrically operated shoe type spring set brake equally effective in both directions of motor rotation, and of sufficient size to bring the motor quickly to rest and to sustain rated capacity loads. It shall automatically set at all times when current is not flowing to the motor.

Mechanical Load Brake. (Include on A.C. cranes, optional on D.C. cranes.) A separate self-contained automatic mechanical load brake of the multiple disc type shall be interposed in the hoist gear train between the first and second gear reductions. It shall be of the proper size to hold the capacity load and control the speed of lowering under all conditions. It shall be free of initial friction. A differential holding band shall be utilized to hold the brake casing stationary in the lowering direction. Friction discs shall alternately be cast iron and heat resisting woven asbestos material. The iron discs shall be accurately machined with each side ground parallel and highly polished.

Trolley Drive Mechanism. The trolley drive mechanism shall consist of an electric motor driving by means of spur gear reductions one of the trolley wheel axles to which shall be keyed the two driving wheels. Gearing shall be totally enclosed in an oil tight housing. Wheel axles shall be made from open hearth steel accurately machined and ground to size to receive the inner races of the roller bearings. Wheels shall be keyed to the axles. Trolley wheels shall be of the double flanged type made from car wheel iron with deeply chilled treads or rolled steel. Wheel axles shall be of the rotating axle roller bearing type. Roller bearings shall be mounted in cast iron bearing cartridges held in place by caps and through bolts. Bearing cartridges shall be designed to retain grease and exclude dirt. The bearings shall be split diagonally to relieve the cap holding bolts from thrust.

Gearing. All gears shall be spur type with machine cut teeth from solid stock. Gears shall be made from either rolled or cast steel; pinions shall be made from alloy steel and heat treated.

Bearings and Lubrication. All bearings shall be roller bearings. They shall be mounted in cast iron cartridges designed to retain grease and exclude dirt. Cartridges containing bearings shall be held in position by caps and bolts. All hoist and trolley drive gearing shall be enclosed in substantial housings and operate in an oil bath. Convenient hand holes and screw plugs shall be provided in the cases for convenience in oiling and inspection. Axle bearings shall be packed in grease and shall require infrequent lubrication.

Lifting Tackle. The lifting tackle shall consist of a safety type lower block and hook, necessary sheaves, and flexible steel wire rope. The lower block shall be a heavy steel

Hoist Machinery. Hoist machinery shall consist of a motor, motor brake, grooved winding drum, gearing, and mechanical load brake, all built into a compact, readily accessible unit supported on the trolley frame. Motor shall be flange mounted to insure positive permanent alignment. All gearing and load brakes shall operate in oil in a sealed enclosure.

Hoist Gear Train. Hoist gear train shall consist of two gears and pinions, to transmit the power of the motor to the winding drum. Gears shall be made from high carbon steel with machine cut teeth. All bearings shall be roller bearings. Lubrication shall be accomplished by pouring oil into gear housing at one point.

Brakes. Hoisting mechanism shall be equipped with an electrical and a mechanical load brake to hold and control the load. Electric brake shall be spring set and released by a solenoid magnet whenever current is flowing to the motor. Brake shall be of shoe type and easily adjusted for wear. The automatic mechanical load brake shall be of the double disc Weston type with large friction surfaces and operate in oil. Its function is to hold the load and prevent the load accelerating when being lowered.

Lifting Tackle. The lifting tackle shall consist of a safety type lower block and hook with necessary sheaves and flexible wire rope. The lower block shall be a heavy steel housing to support the sheaves and hook. The hook shall be forged steel and shall be supported on a ball bearing thrust. Sheaves shall be of heavy pattern and have deep flanges and shall be properly grooved to fit the rope and properly guarded. The wire rope shall be flexible steel wire rope made especially for crane service.

Trolley Drive Machinery. Trolley drive mechanism shall consist of a motor transmitting its power to the trolley drive axle to which the two driving wheels are keyed through a totally enclosed non-locking worm gear set. Worm wheel shall be of bronze and worm of steel with machine cut teeth. Connection to driving axle shall be by a coupling, removal of which disconnects the mechanism from the axle and permits removal of axle and driving wheels without disturbing the mechanism.

Trolley Wheels and Axles. Wheels shall be of double flange type made from car wheel iron with deeply chilled treads or forged or rolled steel. All wheels shall be pressed on their axles and the driving wheels keyed to their axle. Axles shall be of high carbon steel and their bearing assemblies shall be supported in diagonally split bearings.

Current Collectors. Current collectors shall be slide type arranged so that contact with the bridge cross wires is maintained. Collectors shall be mounted on insulated trolley pole or poles suspended from the trolley.

Wiring. All wiring shall be done in a neat and workmanlike manner, and wherever possible shall be run in wiring ducts built into the trolley frame.

Electrical Equipment. For electrical specifications, insert those as given for the Type "LHR" crane.

As an alternate, single speed squirrel cage motors with pendant push button control may be specified without incurring appreciable additional expense.

HAND OPERATED DOUBLE GIRDER TRAVELING CRANE, WIRE ROPE AND DRUM TYPE HOIST, "SHAW-BOX" TYPE "BR" OR EQUAL

GENERAL

The intent of this specification is to provide for a complete hand operated crane of modern design, which when erected will be ready for use.

Crane shall, before shipment, be completely assembled, neatly finished, and painted. All parts of the crane inaccessible after assembly shall be painted before being assembled. All bright parts shall be covered with slushing compound to prevent rust while crane is in transit.

TYPE

The crane shall be a hand operated crane of the single trolley double girder type of   tons capacity. (If two trolleys are desired on the bridge, each one-half of the capacity of the crane, give the capacity of each trolley state the spacing between them when the crane must handle capacity loads.)

The crane shall be of the wire rope and drum type. It shall be designed to operate within the space shown on the accompanying building plans. (If plans are not a part of the specifications, insert here the information suggested on "Inquiry Data.")

GUARANTEE

The crane shall be guaranteed by the manufacturer to be of accepted modern design, free from inherent defects in either workmanship or material; and, to safely handle its rated capacity load without any undue deflections in its structure or mechanism. All materials shall be the best of their respective kinds. Any parts proving defective within one year from date of shipment shall be replaced free of charge by the manufacturer.

BRIDGE

Girders. The bridge shall consist of two girders supported on the crane end trucks. The girders shall be designed to safely carry the full rated load of the crane without undue vertical or lateral deflection or vibration. The girders, dependent upon the capacity and span of the crane, may be rolled steel wide flange I-beam sections, or wide flange I-beam sections with their top flanges reinforced by steel plate or

SINGLE GIRDER CRANE BRIDGES

SINGLE GIRDER TOP RUNNING ELECTRICALLY OPERATED CRANE BRIDGE—"SHAW-BOX" TYPE "SBE"

General. The intent of this specification is to provide for a complete electrically operated crane bridge of modern design which when erected will be ready for use.

Bridge shall, before shipment, be completely assembled, wired, neatly finished and painted. All parts inaccessible after assembly shall be painted before assembly. All bright parts shall be covered with slushing compound to prevent rust while bridge is in transit.

Type. The bridge shall be an electrically operated bridge of the single girder top running type of .... tons capacity. It shall be designed to operate on the tracks and within the space shown on the accompanying building plan. (If plans are not included insert here information suggested on "Inquiry Data.")

Girder. The main girder shall be a steel I-beam of proper weight and section to carry the full rated load of the bridge without undue lateral or vertical deflection or vibration. In addition to the main girder there shall be an auxiliary steel channel extending the full length of the bridge, on the drive side, supported from the end trucks and horizontally braced to the main girder to form a truss designed to support at least one-half of the weight of the bridge drive machinery and motor.

End Trucks. End trucks shall be built from rolled steel I-beam sections and designed to provide a support for a bearing at each side of the truck wheel. Provision shall be made for easy removal of wheels and axles. Bearing boxes to support the truck wheel axles shall be assembled in the end trucks.

Wheels and Axles. Wheel axles shall be of the rotating type and made from open hearth steel accurately machined and ground to size to receive the inner race of the ball bearings. Wheels shall be keyed to the axles. Wheels shall be of the double flanged type made from car wheel iron and have deeply chilled treads and shall be ground to equal diameters in pairs to fit the rails on which they are to operate.

Bridge Drive Machinery. Bridge drive machinery shall consist of an electric motor driving a cross shaft through a self-contained spur gear speed reducer unit which is connected by means of couplings to the two (2) driver axles. Motor shall be flange mounted on the speed reducer unit. Mounted on the bridge drive motor shaft shall be a magnetically operated brake to control the drift of the bridge. The cross shaft shall be made from high-grade cold rolled steel and shall be supported at frequent intervals along the bridge in permanently aligned bearings.

Gearing. All gears shall be of the spur type with machine cut 20° stub teeth. All gears and pinions shall be made from high carbon steel forgings.

Bearings and Lubrication. All bearings shall be high-grade heavy duty radial thrust ball bearings. Gears in the speed reducer unit shall operate in an oil bath in a sealed enclosure. Axle bearings, motor bearings and cross shaft bearings shall be packed in grease and require infrequent lubrication.

Operation. Bridge shall be operated by pendent cords or push buttons hanging to within easy reach of the floor. Controller shall be mounted on (state whether on bridge and give location; or, on hoist).

Motor and Controller. Motors shall be ball bearing. (If for Alternating Current, insert: "wound rotor variable speed slip ring type." If for Direct Current insert: "series wound variable speed type) wound for operation on (insert characteristics of electric current available) of proper size to drive the bridge at its rated speed without undue heating. The controller shall be a variable speed drum type with large copper contacts and renewable contact fingers with at least three operating speeds or magnetic contactors. Controller shall be located (give location desired.)

Wiring. Bridge shall be equipped with current collectors mounted on an insulated pole for picking up current from the runway wires. Electrical connections between collectors, controller and motor shall be made by the manufacturer in his shop before shipment. If electric hoist is to be used on the bridge add: "Bare copper cross wires with strain insulators shall be mounted on the bridge to supply current to an electric hoist."

Hoist and Trolley. The hoist and trolley unit may be either a hand operated trolley and chain hoist or an electrically operated hoist and trolley.

SINGLE GIRDER TOP RUNNING CRANE BRIDGE— "SHAW-BOX" TYPE "SBR"

General. The intent of this specification is to provide for a complete hand operated crane bridge of modern design which when erected will be ready for use.

Crane shall, before shipment, be completely assembled, neatly finished and painted. All parts of the crane inaccessible after assembly shall be painted before being assembled. All bright parts shall be covered with a slushing compound to prevent rust while crane is in transit.

Type. The crane shall be a hand operated crane of the single girder type of ______ tons capacity. It shall be designed to operate within the space shown on the accompanying building plan. (If plans are not a part of the specification, insert here the information suggested on the above Inquiry Data.)

Girder. The main girder shall be an I-beam of proper section to safely carry the full rated load of the crane without undue vertical or lateral deflection or vibration. If necessary, because of either length of span or capacity, the top flange shall be reinforced by a steel channel either welded or riveted thereto. The girder shall be notched at each end and seat angles shall be welded to the girder to form a connection to the end trucks. The girder shall be connected to the top and side of each truck in such manner that skewing will be prevented. Machined fit bolts shall be used.

End Trucks. Each end truck shall consist of two steel channels connected together by steel plates, top and bottom, electrically welded together to form a rigid box section. Trucks shall be designed so that wheel loading is equally distributed to each channel. Holes for wheel axles shall be accurately bored.

Wheels and Axles. Wheel axles shall be of the stationary type and made from steel and ground to size to receive the inner race of the roller bearings. Axles shall be prevented from turning or working endwise by means of a key plate fitting into a milled slot in the end of the axle and bolted to the end trucks. Wheels shall be of the double flanged type made from semi-steel or other suitable wheel material, and shall be accurately machined to suit the rail on which they are to operate.

Bearings and Lubrication. Bearings in the bridge wheels shall be Roller Bearings. Cross shaft bearings shall be smoothly finished grey iron. They shall be accurately and permanently aligned. Provision shall be made for grease lubrication through high pressure fittings.

Gearing. Gearing shall be of the spur type with machine cut 20° stub teeth. Pinions shall be made from steel forgings; gears shall be made from semi-steel or cast iron.

Bridge Drive. Bridge movement shall be effected by pulling on an endless chain hanging to within 18 inches of the floor line. Chain wheel shall be equipped with a swinging chain guide to effectively prevent "gagging" of the chain when being rapidly handled. Operating wheel shall be attached to a cross shaft made from high-grade cold rolled steel, which shall extend the full length of the bridge, on one side. Cross shaft shall be supported at frequent intervals in bearings. A pinion shall be keyed to each end of the drive shaft to engage the gears on the driving truck wheels.

(If electric hoist is to be used on the bridge insert the following paragraph.)

Wiring. The bridge shall be equipped with current collectors mounted on an insulated trolley pole, strain insulators, and bare copper cross wires to supply current to an electric hoist.

Hoist and Trolley. The hoist and trolley unit may be either a hand operated trolley and chain hoist or an electrically operated hoist and trolley.

(c) Is the brake single disc, double disc, or multiple disc type? Multiple disc is preferable in most cases because of the low pressure per square inch of braking surface.

(d) Is it of the dry disc requiring only a slight amount of oil or wet disc type? Dry disc type, unless the brake discs are all metal and operated in an oil bath with provision made to control the amount of oil between them, is preferable because constant coefficient of friction between plates is maintained.

(e) Is the retaining medium to hold fixed member stationary in the holding direction a pawl and ratchet, or a differential holding band?—The holding band minimizes back lash.

(f) Is the brake self-adjusting, or must it be frequently adjusted to maintain its effectiveness?

Hoisting Rope. Is the rope flexible construction (6 x 37 or 8 x 19) and of proper size to give a factor of safety of at least five when fully loaded? (See Section V for strength of cables.)

Lower Block and Hook.

(a) Is the hook a steel forging?

(b) Is the hook supported on a ball bearing thrust so that it turns easily under full load?

(c) Are the sheaves fully guarded so that rope cannot come off, so that a careless workman's hands cannot become caught between the ropes and the sheaves?

Motors. Motors designed particularly for crane service are manufactured by the principal motor manufacturers and by some crane builders themselves, so it should be determined that the motors are either of the crane builders own manufacture, or manufactured by a reputable motor manufacturer.

Because equivalent horsepowers can be obtained in a variety of speeds and frame sizes, it is essential that in checking the values represented by the motors, in addition to being checked for horsepower rating, they should be checked on the basis of their r.p.m. when delivering their rated horsepower and the basis on which they are rated. Slow speed motors cost more than high speed motors. Likewise, motors rated on the basis of a 55° temperature rise after 15 minutes running under full load are less expensive than motors rated on a 55° rise after 30 minutes running.

Controllers. Controllers should be of either the crane builders own make, or manufactured by a reputable control manufacturer. They should be checked on the following points:

(a) The number of steps of speed of control they give.

(b) The type and kind of material used in the resistors.

Switchboard. The switchboard should be enclosed in a steel cabinet and should contain main line switch overload protection for each motor and magnetic contactor for the limit switch. In addition to this, it should be checked as follows:

(a) Is the operating handle for the main line switch conveniently located outside of the enclosed cabinet so that it may be quickly pulled in case of emergency?

(b) Can the main line switch be locked open?

Limit Switch and Safety Features. Check type of and method employed to operate the upper limit switch.

(a) How is it operated?

(b) Does it carry the full load current, or does it open a pilot circuit? A pilot circuit is preferable.

Is the switchboard totally enclosed?

Is crane equipped with:

(a) Bumpers?

(b) Rail sweeps?

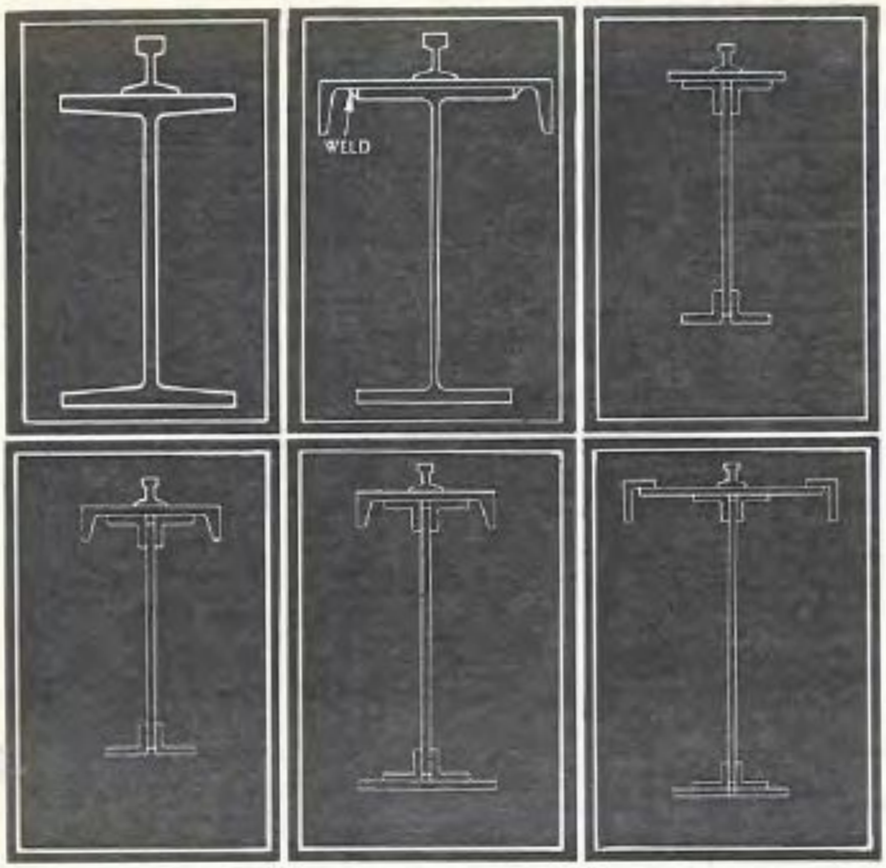
(c) Warning gong?

Weight and Cost Per Pound. In the present era evaluating a crane on a "cost per pound" basis immediately establishes a false premise. The aim of the modern engineer is to reduce dead weight and at the same time increase the strength and life of the machine. For that reason alone have the new alloy steels, heat treatments, and new production methods been developed. A case in point, comparable with the advance made in crane design and production during the past five years, is the modern automobile.

Hence, the values contained in any crane can better be determined by analyzing its design and construction on the points enumerated in the foregoing.

Comparing Prices. After the above suggested analysis has been completed, appraise in dollars the value of each modern detail or feature not contained in each offering. Then, if the price of each offering is debited or credited, as the case requires, with the valuation set up, a true picture of the dollar value of each offering is immediately available.

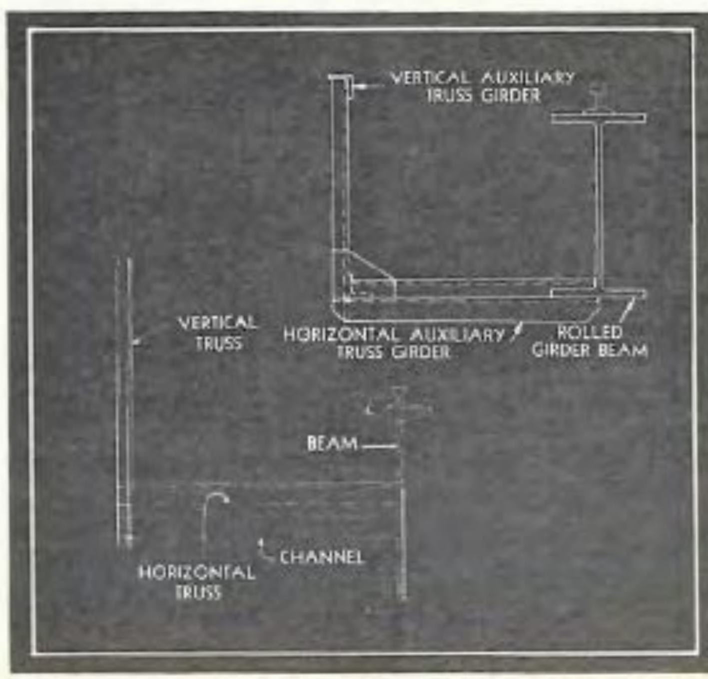
SINGLE WEB GIRDERS



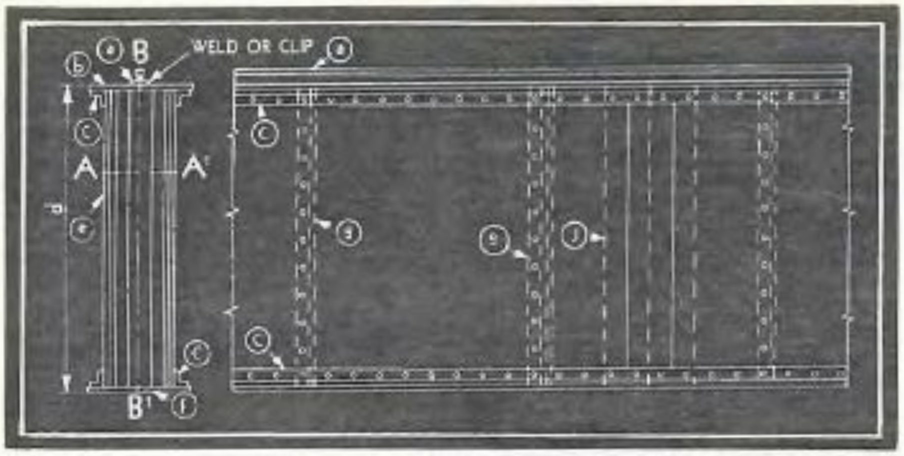
At the left are illustrated the make-up of the various types of Single Web Girders that are employed in crane construction and in the construction of crane runways. Notice that common to all of the fabricated types is the increased section in the top flange to keep the compressive stresses within limits that have been established for compression. Before determining upon the use of a Single Web Girder built-up section, a careful comparison of girder sections, weight, and cost compared with that of a suitable Box Section Girder should be made. Usually, it will be found that a properly designed Box Section Girder will be lighter in weight, have better properties, and in operation it will have a greater lateral stability and vibrate less when the crane is handling capacity loads.

AUXILIARY BRACED I-BEAM GIRDERS

This type—a combination of I-beams and trusses on the driving girder to impart lateral stability to the girder and support the bridge drive machinery—results in a very economical type of construction, both as to weight and cost, for cranes of moderate capacity, and much longer span than would be practical with either I-beam or Single Web Girders. When the $\frac{L}{B}$ is greater than recommended practices for I-beams, this situation is corrected by reinforcing the top flange of the I-beam with a channel or plate.



PANEL OF BOX SECTION GIRDER



$A\text{-}A_1$ = Horizontal Neutral Axis

$B\text{-}B_1$ = Vertical Neutral Axis

a = Trolley Rail

b = Top Cover Plate

c = Chord Angles

e = Web Plates

f = Bottom Cover Plate

g = Diaphragms between Web Plates

j = Web Plate Splices

d = Depth of Girder in Inches

l = Span in Inches

r = Radius of Gyration of Top Chord (Cover plate "b" and angles "c" about vertical axis "$B\text{-}B_1$")

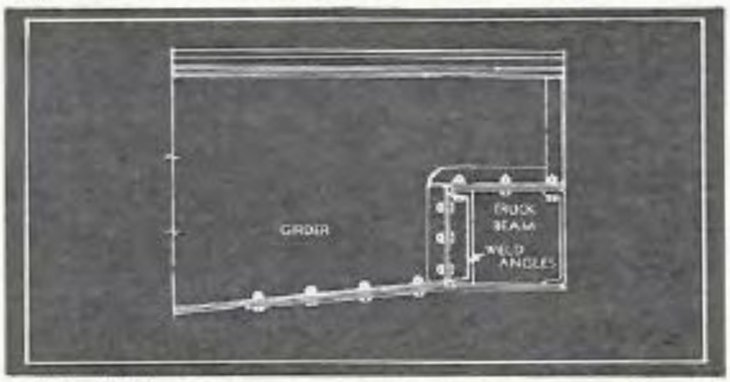
$\frac{l}{r}$ Should be 120 or less:

$\frac{l}{d}$ should be 20 or less.

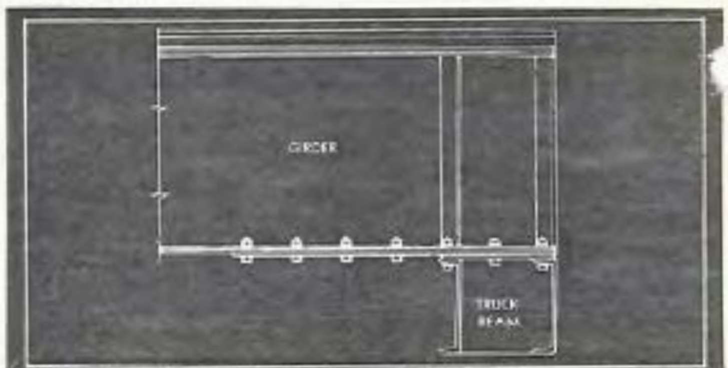
Cover plates and angles should be one piece. Splices are permissible in web plates.

GIRDER END DETAILS

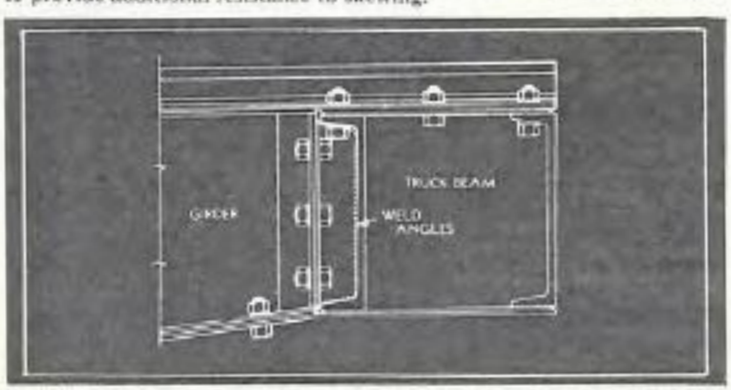
It is paramount importance that the crane girder be attached to the bridge end trucks in such a manner that the girder and trucks become a rigid frame that will not skew during operation. Hence the necessity that particular consideration be given, not only to the design and construction of the girder ends, but to the method employed in connecting them to the bridge end trucks. The drawings shown below are examples of proven girder end construction and truck connections.



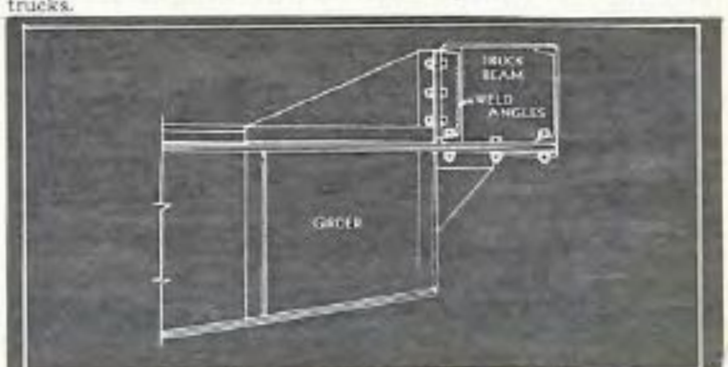
1. "Standard" notched end truck connection used whenever possible. The end trucks fit into the notched ends of the girders. After being perfectly squared they are bolted into place with machined fit bolts. The connections are made at top, side, and bottom of the end trucks. Wide gusset plates are used in the bottom of the trucks to give maximum squaring effect and to provide additional resistance to skewing.



3. Straight girder connected to the top of the end truck only. This connection is only used when it is necessary to obtain maximum clearance below the crane and maximum hook lift. Connection is by machined fit bolts at top of truck only. Wide and heavy gusset plates are used to obtain maximum squaring effect. This construction is not recommended for high speed, continuous duty cranes as it permits girder to "roll" on the end trucks.



2. "Flush" type end connection used when, because of head room condition, it is impossible to use standard connection. The top cover plate of the girder extends beyond the girder ends and over the top of the end truck. After being perfectly squared the end trucks are fitted to the ends of the girders and bolted to them. Connections are made at the top, side, and bottom of the end truck by machined fit bolts. Wide gusset plates are used at bottom of truck for maximum squaring effect.



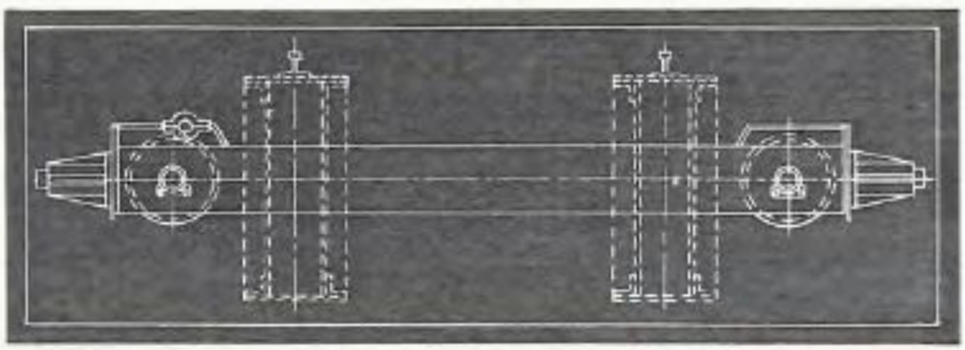
4. "Dropped" girder end truck connection. Used only to meet unusually low head room conditions. Girders are supported from the side and bottom of the end truck. Connections are made by machined fit bolts. This construction reduces the amount of trolley travel and prevents close hook approach to each side of the crane way.

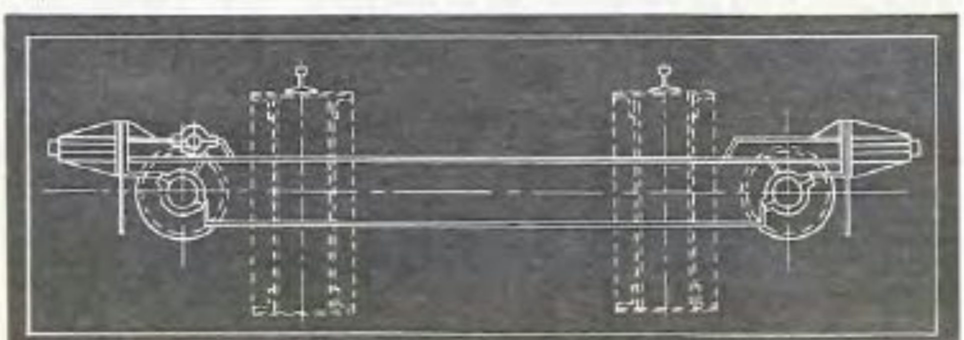
TYPES OF END TRUCKS

The type of end truck that should be used to support the bridge girders is dependent upon the type of service, wheel load, and speed of the crane bridge. Drawings of the types of end trucks used to meet the various conditions encountered in crane building are shown. Standard practice is to use two-wheel trucks (one at each end of the bridge) until the wheel load of the crane or the bearing pressure on the wheel axles becomes greater than the carrying capacity of the wheel or bearings. To hold the maximum wheel loading and axle bearing pressures within the limits experience has shown to be correct additional wheels are used to support and carry the crane. On large capacity cranes each girder is supported on a pair of two-wheel end trucks; and on extremely large capacity cranes each girder is supported on two pairs of two-wheel end trucks to distribute the wheel loads and keep axle bearing pressures within reasonable limits.

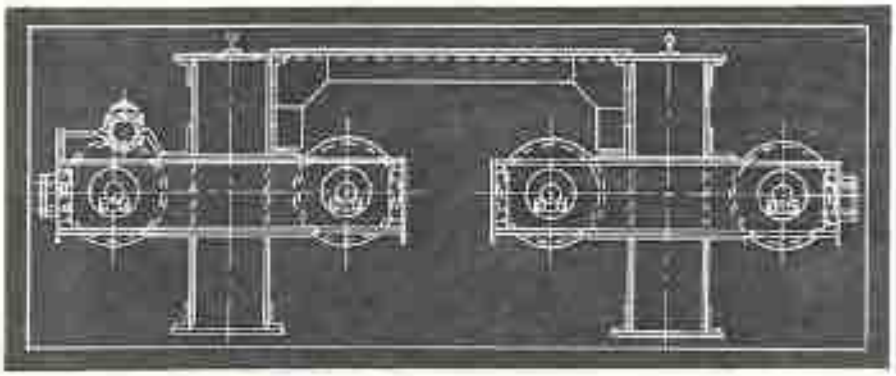
FOUR WHEEL CRANES

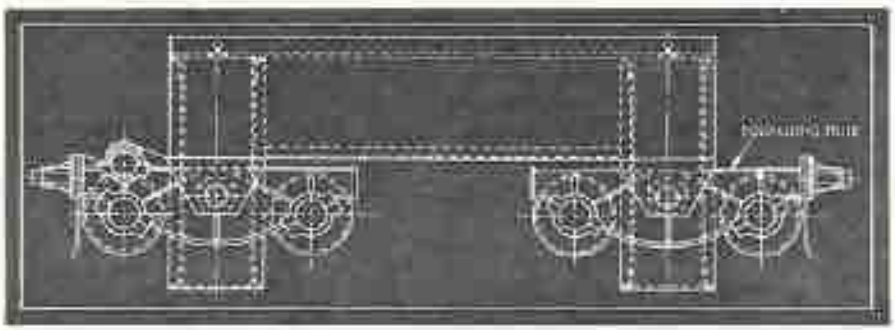
When the maximum wheel load of a crane does not exceed 90,000 pounds per wheel, and the crane runway permits it, the crane girders are supported on a two-wheel truck at each end of the crane. Girders are connected to the trucks in such manner that the entire structure becomes a rigid rectangular that will not weave or twist. Illustrated are two typical designs of two-wheel end trucks. The truck at the top is equipped with stationery wheel axles, the wheels being equipped with either roller or bronze bearings, dependent upon the service. The bottom illustration shows a two-wheel truck with rotating wheel axles. In this design, the bearings for the wheel axles which revolve on roller bearings are split diagonally to provide for easy removal of the wheels and relieve the cap holding bolts from shear.

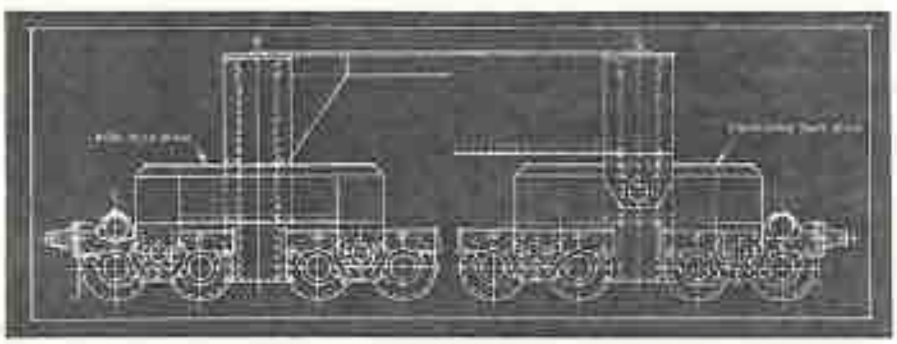




EIGHT AND SIXTEEN WHEEL CRANES





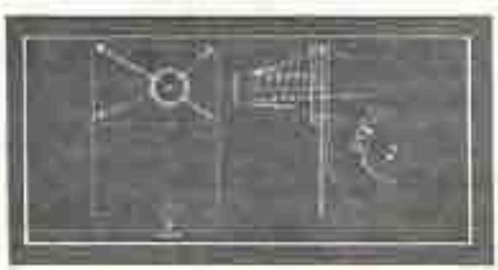


On large capacity cranes when wheel loading is above 90,000 pounds per wheel, each girder is supported on a pair of two-wheel end trucks, and on very large capacity cranes each girder is supported on two pair of two-wheel end trucks to distribute the wheel loading and keep the axle bearing pressures within reasonable limits. The top drawing is of crane with stationary axles and with the girders connected together by a substantial flexible tie that acts as a draw bar between the driving and idle girder. Because the girders are each supported on individual trucks, wheel load is equally distributed. One wheel at each end of the crane is a "drive" wheel.

The second drawing shows a crane with rotating axle, equalizing end trucks, and with a rigid girder tie. This construction is used on heavy capacity cranes for continuous industrial service, steel mill cranes, or heavy capacity cranes having fast bridge speeds. The girders are rigidly connected together at each end to form a rigid frame and the whole supported at each corner by a two-wheel truck. The connection at the truck is by a heavy equalizer pin. Each truck being free to oscillate on the pin, the wheels will assume their loading without distorting the bridge structure.

The lower drawing shows construction used on especially heavy capacity cranes. Where wheel loading is beyond that satisfactory for eight wheels, then sixteen wheels are used (four two-wheel end trucks at each end of the crane). All truck connections are by equalizer pins. The girder tie may be flexible or rigid. Both types of ties are shown in the composite drawing. When a flexible girder tie is used, each end of the girder is supported on a rigid truck beam supported on two equalized two-wheel trucks. When the rigid girder tie is used the truck beam, in addition to the two-wheel trucks, are equalized. In each case, the wheel loading is equally distributed. With this construction, at least four of the sixteen wheels are drivers.

BUMPERS FOR END TRUCKS

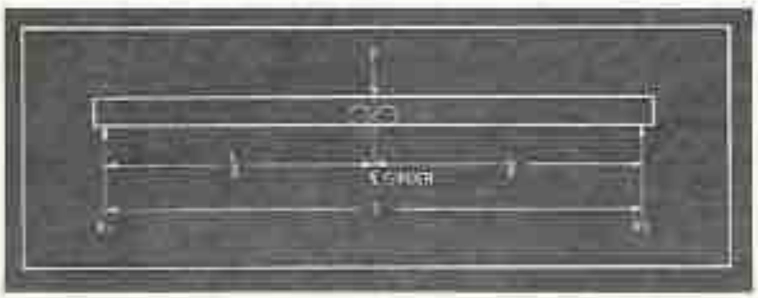


As a safety precaution, and to prevent damage to the crane, the end trucks should be equipped with bumpers and rail sweeps. The bumpers are to engage stops on the ends of the crane runway, or other cranes on the same runway; the rail sweeps are to brush away any object that may fall on the track. A substantial bumper and rail sweep in its simplest form is a heavy steel plate across the ends of the bridge end trucks with a Heart Maple block attached to it as shown in the drawing above. A refinement, and more expensive one, is the spring bumper shown in the drawing at the left.

COMPUTING MAXIMUM BENDING MOMENTS

The first step in designing girders for crane bridges or crane runways is to determine the maximum bending moments that must be resisted by the girders, including those set up by the dead load (weight of the girder) and the maximum load to be imposed upon it. Then, the girder section is designed to resist the maximum bending moment with suitable factor of safety and without undue deflection when loaded to capacity. The formulae that follow cover conditions encountered in crane and runway girder design.

SINGLE TROLLEY ON SINGLE GIRDER BRIDGE

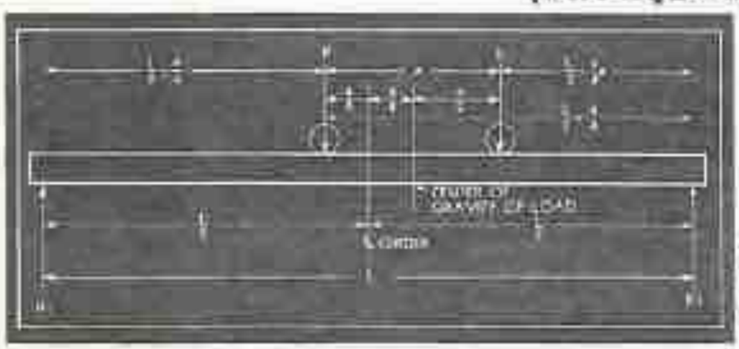


L = Span in inches
P = Live load (weight of trolley plus load)
G = Dead load (weight of girder, shaft, and brackets) in pounds
R_1 and R_2 = End reactions due to live load
M_b = Maximum bending moment in inch pounds

$$R_1 = \frac{P}{2}$$

$$M_b = \frac{PL}{4} + \frac{GL}{8}$$

SINGLE TROLLEY ON DOUBLE GIRDER BRIDGE
(Two Equal Rolling Loads)



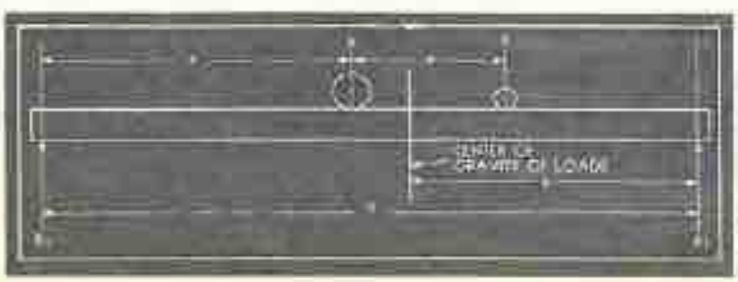
L = Span in inches P = Live load in pounds
R_1 and R_2 = End reactions due to live load
G = Dead load (weight of girder, platform, and machinery) in pounds
a = Trolley wheel base (inches)
M_b = Maximum bending moment in inch pounds

$$R_1 = P\left(\frac{L}{2}+\frac{a}{4}\right) + P\left(\frac{L}{2}-\frac{3}{4}a\right) = P - \frac{Pa}{2L}$$

$$M_b = R_1\left(\frac{L}{2}-\frac{a}{4}\right) + \frac{GL}{8} = \frac{P}{2L}\left(L-\frac{a}{2}\right)^2 + \frac{GL}{8}$$

If "a" is greater than .586L, one load at center gives a greater bending moment. Maximum bending moment occurs under one of the loads when that load is as far from one reaction as the center of gravity of both loads is from the other reaction. Both are $\left(\frac{L}{2}-\frac{a}{4}\right)$ from their respective reactions.

SINGLE TROLLEY ON DOUBLE GIRDER BRIDGE
(Two Unequal Rolling Loads)



L = Span in inches p = Small live load
a = Trolley wheel base (inches)
P = Large live load R_1 and R_2 = End reactions due to live loads
G = Dead load (weight of girder, platform, and machinery) in pounds
M_b = Maximum bending moment in inch pounds

$$R_1 = \frac{P(L-x)+p(L-(x+a))}{L} = \frac{x}{L}(P+p)$$

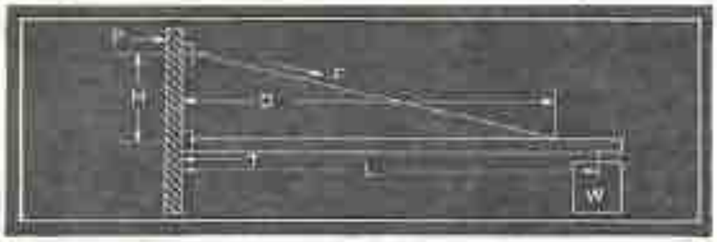
$$x = \tfrac{1}{2}\left(L-\frac{pa}{P+p}\right) \qquad M_b = R_1x + \frac{GL}{8} = (P+p)\frac{x^2}{L} + \frac{GL}{8}$$

If "a" is greater than .586L, one load at center gives a greater bending moment.

Maximum bending moment occurs under the larger load when that load is as far from one reaction as the center of gravity of both loads is from the other reaction.

JIB CRANES

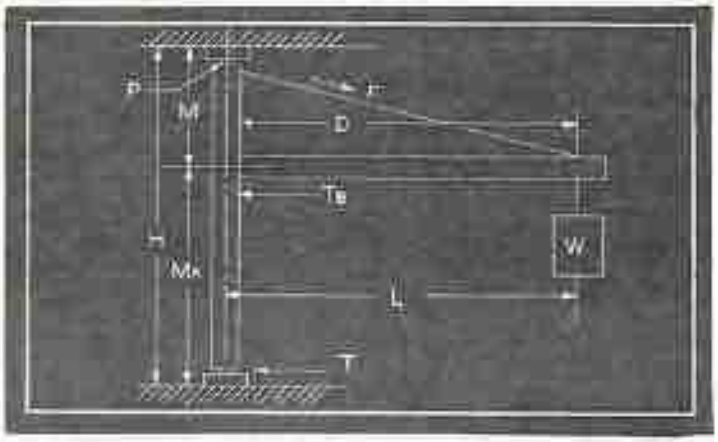
In addition to computing bending moments on jib cranes, it is necessary to compute the pull and thrust exerted by the jib crane or the member to which it is attached. In addition to the tension "pull" and compression in the various sections of the jib cranes, it should be remembered that jib cranes set up exceedingly large pulls and thrust on the building structure, and before installing them building construction should be carefully checked. The formulae cover the most popular types of jib cranes.



SWINGING BRACKET

$$P \text{ and } T = \frac{WL}{H}$$

$$F = \frac{P}{D} \times \sqrt{D^2 + H^2}$$

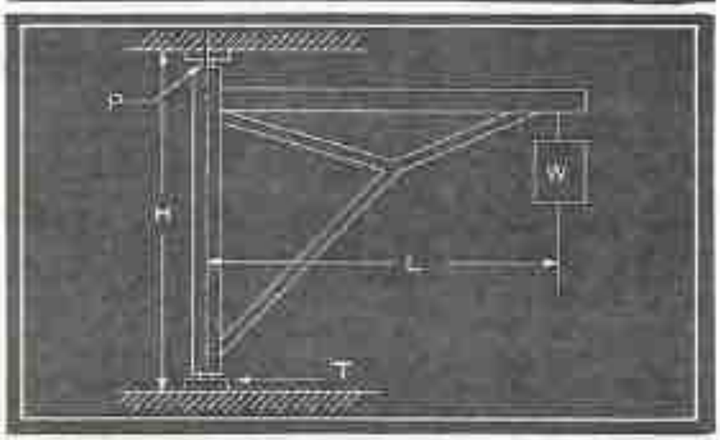


TOP BRACED JIB CRANES

$$P \text{ and } T = \frac{WL}{H}$$

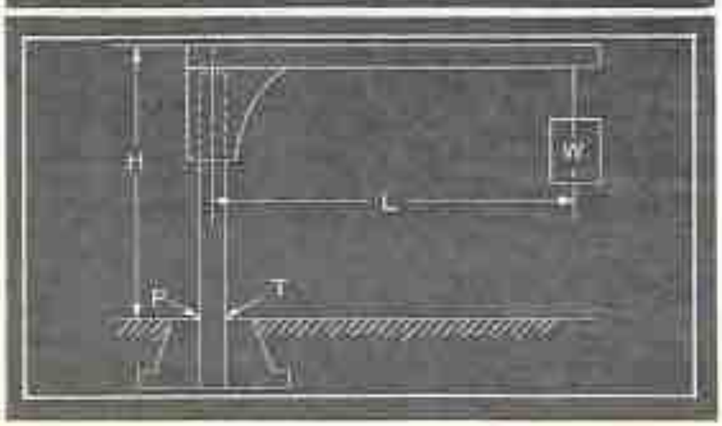
$$F = \frac{P}{D} \times \sqrt{D^2 + M^2}$$

$$TB = \frac{WL}{M}$$



UNDER BRACED JIB CRANES

$$P \text{ and } T = \frac{WL}{H}$$



SELF SUPPORTING JIB CRANES

Bending Moment in Mast = WL

P and T = WL

P = Pull in pounds
T = Thrust in pounds
L = Length in feet
W = Weight in pounds
F = Tension in pounds

With loads imposed determined, calculate bending moments using applicable formula.

COMPUTING MAXIMUM WHEEL LOADS

Of utmost importance to a successful crane installation is the runway or track on which the crane operates. The runway must be designed to resist the loading set up by the crane and properly fabricated. It is of utmost importance that when the runway is erected it be accurately lined up and leveled and be of correct span its entire length.

Runways must be designed to resist the maximum wheel loading imposed by the crane or cranes. Below are the formulae for determining the wheel loading imposed upon runways by cranes so that from them the maximum bending moments may be computed.

COMPUTATIONS

FOUR WHEEL CRANES
Two Wheels Per Truck

On Four Wheel Cranes, the maximum wheel load occurs at R,A shown on the diagram at the bottom of this page, and is approximately equal to the total of the following, in pounds:

½ weight of load
½ weight of trolley
¼ weight of girders and trucks
½ weight of bridge drive machinery and platform
Total weight of cage
W = 10% of weight of trolley and load on each runway
P = 20% of maximum wheel load (each end)

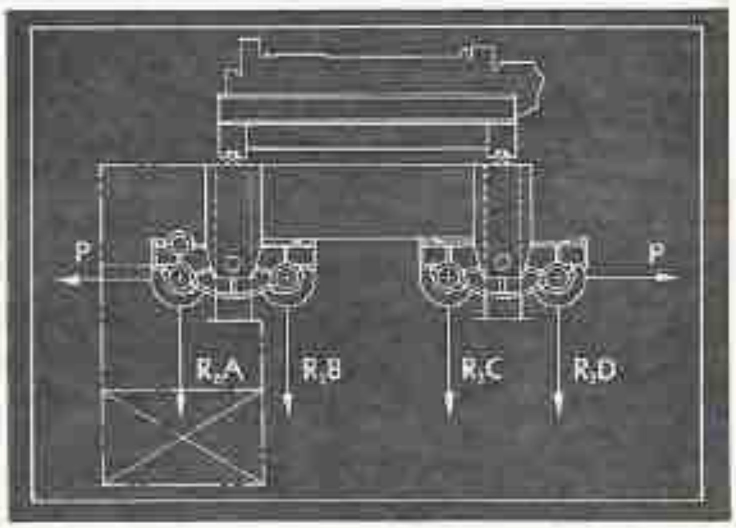
EIGHT WHEEL CRANES
Four Two-Wheel Trucks

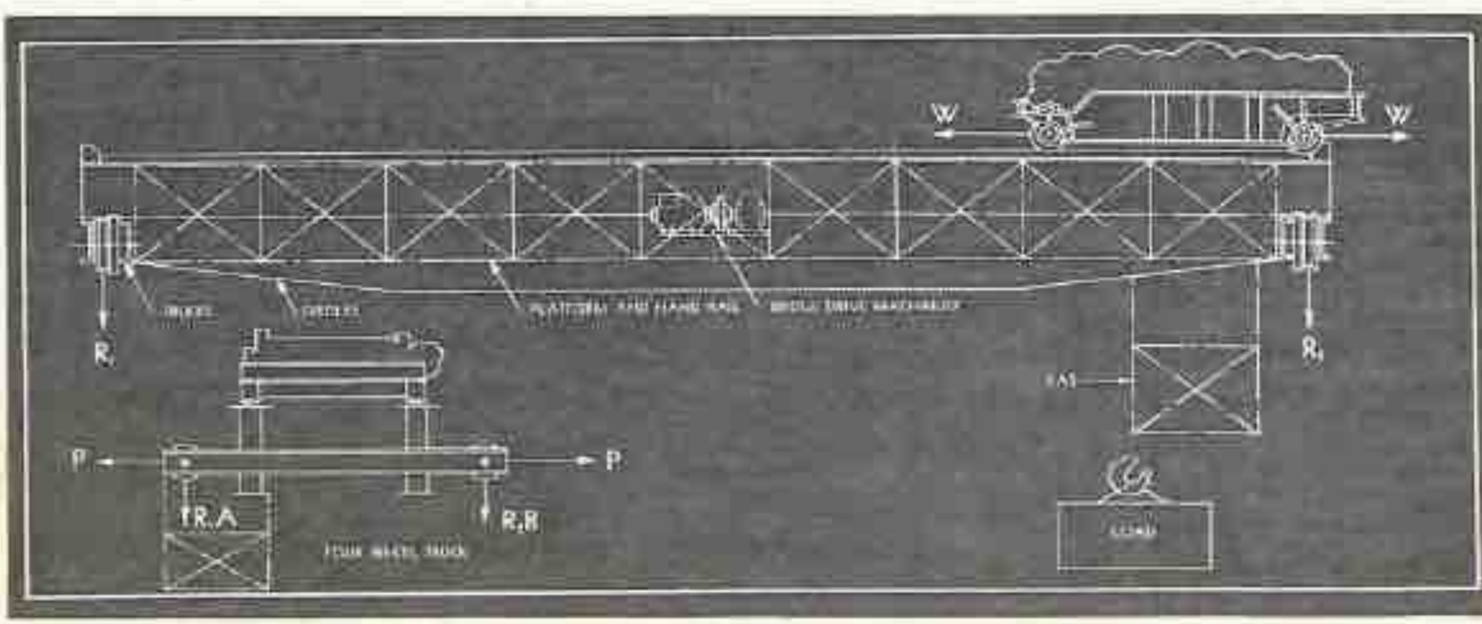
On Eight Wheel Cranes, the maximum wheel load occurs at R,A as shown on diagram at the right, and is approximately equal to the total of the following, in pounds:

¼ weight of load
¼ weight of trolley
⅛ weight of girders and trucks
¼ weight of bridge drive machinery and platform
½ weight of cage
W = 10% of weight of trolley and load on each runway
P = 20% of maximum wheel load (each end) with 2-wheel drive and 40% with 4-wheel drive (2 each end of crane)

MAXIMUM WHEEL LOADS

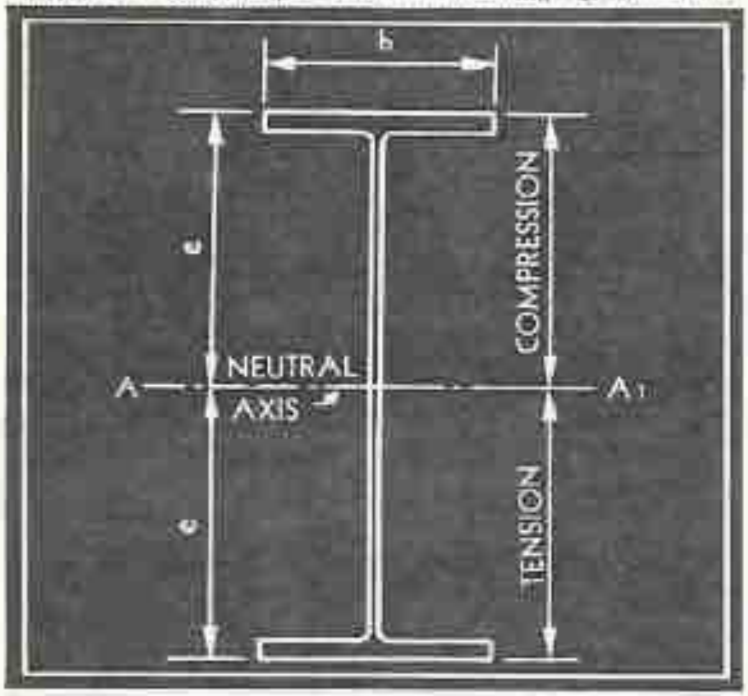
"Maximum wheel load" means the greatest load that one wheel of the crane must carry and occurs when the trolley and capacity load are at the extreme end of the crane bridge. In practice, 90,000 pounds is considered the maximum allowable wheel load for cranes for industrial service.

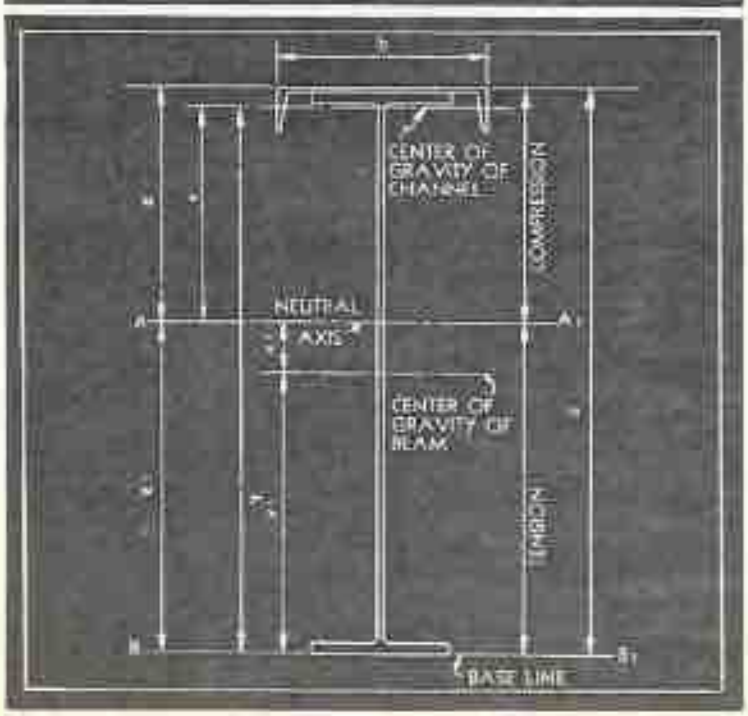




COMPUTING STRESSES IN GIRDERS

After the type of girder has been selected and the sections in its make-up determined, then it is necessary to prove its suitability. This is done by computing the properties of the girder and determining the stresses set up in it both in tension and compression. The formulae applying to the types of girders used in crane practice, whether of welded or riveted construction, are contained on these pages as well as the allowable stresses that practical crane building experience has demonstrated to be correct. In designing crane girders, it is desirable to distribute weight over as much width as practical because of the greater lateral stability obtained. For example, where an area of section of $6\frac{3}{4}$ square inches is required in the top cover plate of a girder, it would be preferable to utilize a plate 18" x $\frac{3}{8}$" rather than a plate 9" x $\frac{3}{4}$". This practice also automatically makes for a wider separation of web plates.





I-BEAM GIRDER
(Symmetrical About Neutral Axis)

(Laterally Unsupported Flanges)

$A\text{-}A_1$ = Neutral axis
I = Moment of inertia about axis $A\text{-}A_1$
e = Distance from neutral axis to outermost fibre in inches
M_b = Maximum bending moment in inch pounds
S = Fibre stress in pounds per square inch
Z = Section modulus
l = Span in inches
b = Width of flange in inches

$$Z = \frac{I}{e}$$

$$S = \frac{M_b}{Z}$$

$$\text{Maximum allowable stress} = \frac{20{,}000}{1 + \dfrac{L^2}{2000b^2}}$$

$$\text{Maximum } \frac{l}{b} \text{ hand operated cranes } 60$$

$$\text{Maximum } \frac{l}{b} \text{ electric cranes } 30$$

I-BEAM AND CHANNEL GIRDER

(Laterally Unsupported Flanges)

$A\text{-}A_1$ = Neutral axis
$B\text{-}B_1$ = Base line
I = Moment of inertia about axis $A\text{-}A_1$
I_c = Moment of inertia of channel about own axis
I_I = Moment of inertia of I-Beam about own axis
d = Depth of section in inches
e = Distance from neutral axis to outermost fibre in compression in inches $(d - e_1)$
e_1 = Distance from neutral axis to outermost fibre in tension (inches)
A = Total area of section
A_c = Area of channel
A_I = Area of I-Beam
M_b = Maximum bending moment in inch pounds
S_c = Fibre stress, pounds per square inch (compression)
S_t = Fibre stress, pounds per square inch (tension)
Z_c = Section modulus, compression
Z_t = Section modulus, tension

$$I = I_c + I_I + A_I X^2 + A_c X^2$$

$$e_1 = \frac{A_c y + A_I y}{A}$$

$$Z_c = \frac{I}{e} \qquad S_c = \frac{M_b}{Z_c}$$

$$Z_t = \frac{I}{e_1} \qquad S_t = \frac{M_b}{Z_t}$$

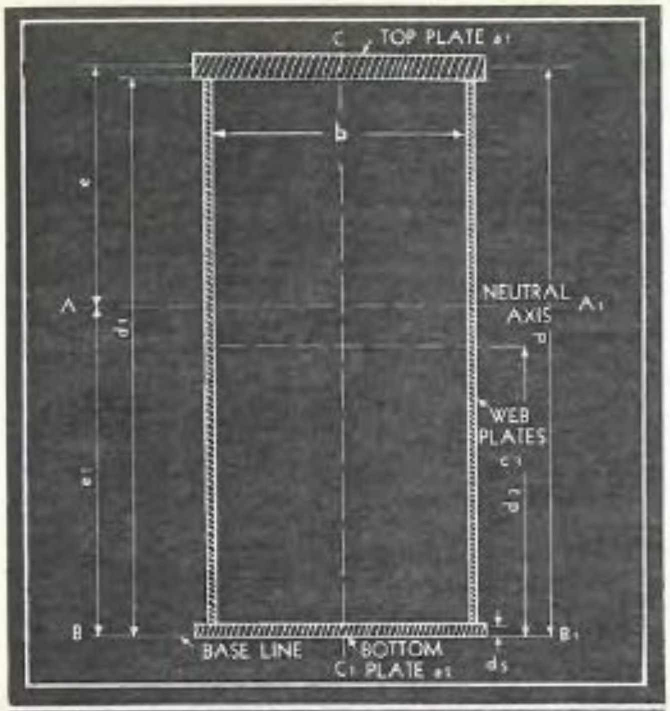
$$\text{Maximum allowable stress} = \frac{20{,}000}{1 + \dfrac{L^2}{2000b^2}}$$

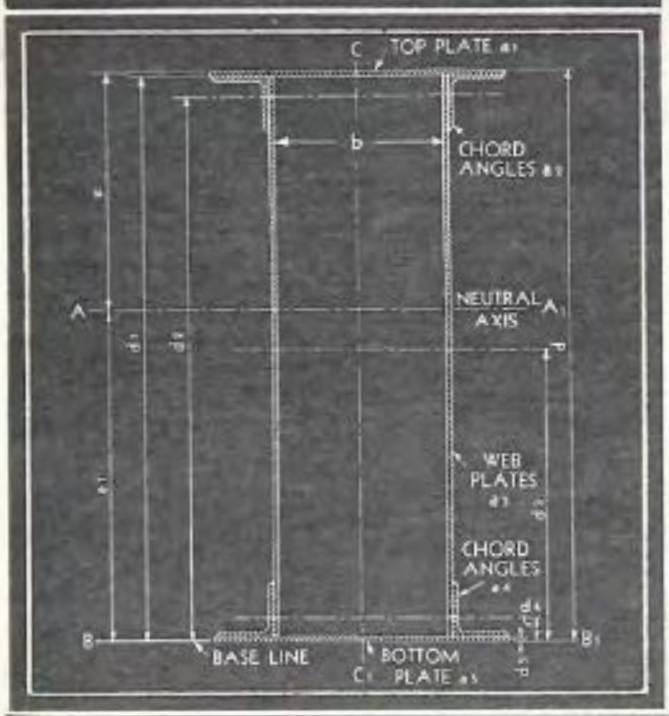
l = Span in inches
b = Width of flange in inches

$$\text{Maximum } \frac{l}{b} \text{ hand operated cranes } 65$$

$$\text{Maximum } \frac{l}{b} \text{ electric cranes } 55$$

BOX SECTION GIRDERS





A-A = Horizontal Neutral Axis
B-B = Base line
C-C = Vertical Neutral Axis
I_c = Moment of inertia about axis C-C
I_a = Moment of inertia about axis A-A
A = Summation of Areas
M = Summation of area moments about B-B
K = Summation areas multiplied by distances squared
l = Span in inches
e_t = Distance from neutral axis to outermost fibre in tension
e = Distance from neutral axis to outermost fibre in compression (d-e_t)
g = Thickness of top cover plate
h = Depth of web
Z_l = Lateral section modulus about axis C-C
Z_t = Section modulus (tension) about axis A-A
Z_c = Section modulus (compression) about axis A-A
M_l = Maximum lateral bending moment
M_b = Maximum vertical bending moment
S_{tl} = Fibre stress (tension) due to lateral bending moment
S_{cl} = Fibre stress (compression) due to lateral bending moment
S_t = Fibre stress (tension) due to vertical bending moment
S_c = Fibre stress (compression) due to vertical bending moment
t = thickness of web

$$e_t = \frac{M}{A} \qquad I_a = K + I\text{ parts} - Ae_t^2$$

$$Z_l = \frac{2I_c}{f} \qquad S_{tl} = S_{cl} = \frac{M_l}{Z_l}$$

$$Z_t = \frac{I_a}{e_t} \qquad S_t = \frac{M_b}{Z_t}$$

$$Z_c = \frac{I_a}{e} \qquad S_c = \frac{M_b}{Z_c}$$

ALLOWABLES

Max. $S_t + S_{tl}$ = 16,000 psi
Max. $S_c + S_{cl}$ = 16,000 psi (reduced when $\frac{b}{g}$ exceeds 41)

Max. $\frac{l}{b}$ welded: 55 riveted: 65

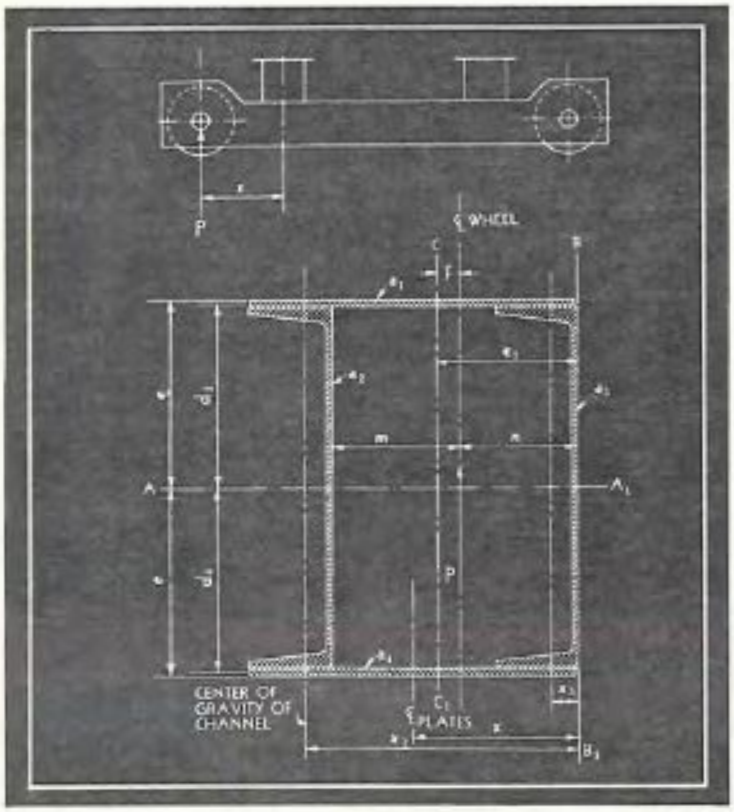
Maximum shear on gross area of web plates = 12,000 psi.
When ratio of depth of web plate to its thickness exceeds 60, the allowable shearing stress in webs shall not exceed:

$$\frac{18000}{1 + \frac{h^2}{7200\,t^2}}$$

TO FIND NEUTRAL AXIS AND MOMENT OF INERTIA					
	Area	Distance	Moment of Area about B-B₁	Area × Distance Squared	Inertia About Own Axis
Top Plate	A_1	d_1	A_1d_1	$A_1d_1^2$	I_1
Two Chord Angles	A_2	d_2	A_2d_2	$A_2d_2^2$	I_2
Two Web Plates	A_3	d_3	A_3d_3	$A_3d_3^2$	I_3
Two Chord Angles	A_4	d_4	A_4d_4	$A_4d_4^2$	I_4
Bottom Plate	A_5	d_5	A_5d_5	$A_5d_5^2$	I_5
Summation	A		M	K	I parts

COMPUTING STRESSES IN END TRUCKS

(When Top and Bottom Cover Plates Are Same Sections)



A-A = Horizontal neutral axis
B-B = Base line
C-C = Vertical neutral axis
I_A = Moment of inertia about axis A-A
I_c = Moment of inertia about axis C-C
A = Summation of areas
M = Summation of area moments
K = Summation of areas multiplied by distances squared
l = Distance from center of axle to center of drive girder in inches
e = Distance from neutral axis to outermost fibre
M_b = Maximum vertical bending moment in inch pounds
P = Maximum wheel load in pounds
S_b = Maximum bending stress due to vertical loading
Z_A = Section modulus about axis A-A
Z_c = Section modulus about axis C-C

$$M_b = Pl$$

$$Z_A = \frac{I_A}{e}$$

$$S_b = \frac{M_b}{Z_A}$$

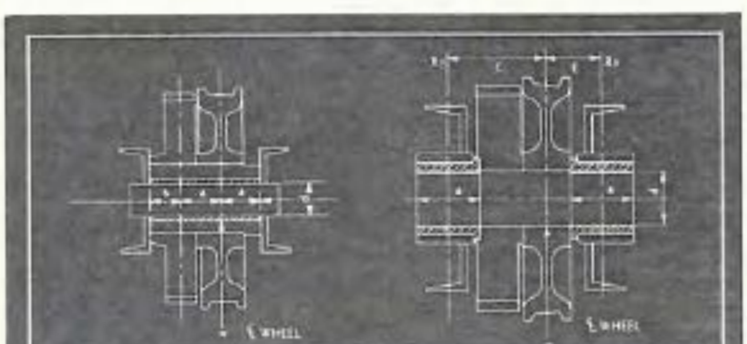
$$e_1 = \frac{M}{A} \text{ (inches)}$$

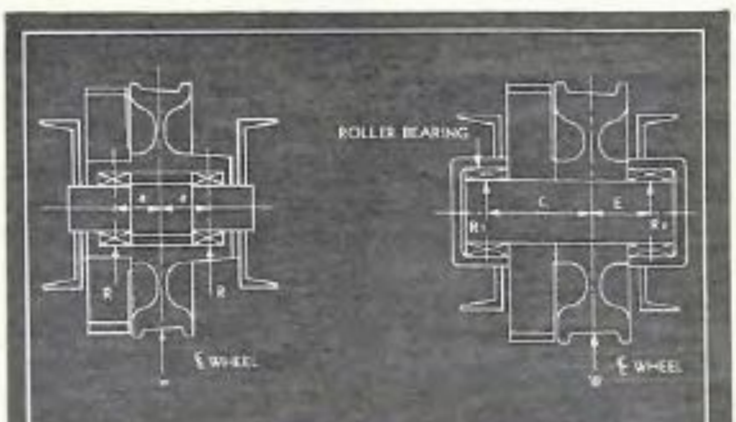
$$I_c = K \quad I \text{ parts} - Ae_1^2$$

$$Z_c = \frac{I_c}{e_1}$$

Only vertical loading has been taken into account above. Lateral bending and possible twisting moments must also be considered. Maximum lateral force is generally considered equal to 20% of maximum wheel load.
To compute moment of inertia see "Box Section Girders."

WHEEL LOADS AND BEARINGS





STATIONARY AXLE

W = Wheel load in pounds
R = Load on bearing

$$R = \frac{W}{2}$$

ROTATING AXLE

W = Wheel load in pounds
R_1 and R_2 = Bearing load in pounds

$$R_1 = \frac{WE}{E + C}$$

$$R_2 = \frac{WC}{E + C}$$

STATIONARY AXLE

W = Wheel load in pounds
d = Diameter of axle
Maximum W = 2000 ad
(a and d in inches)

ROTATING AXLE

W = Wheel load in pounds
a = Length of bearing in inches
d = Diameter of axle in inches
R_2 = Greatest bearing load in pounds

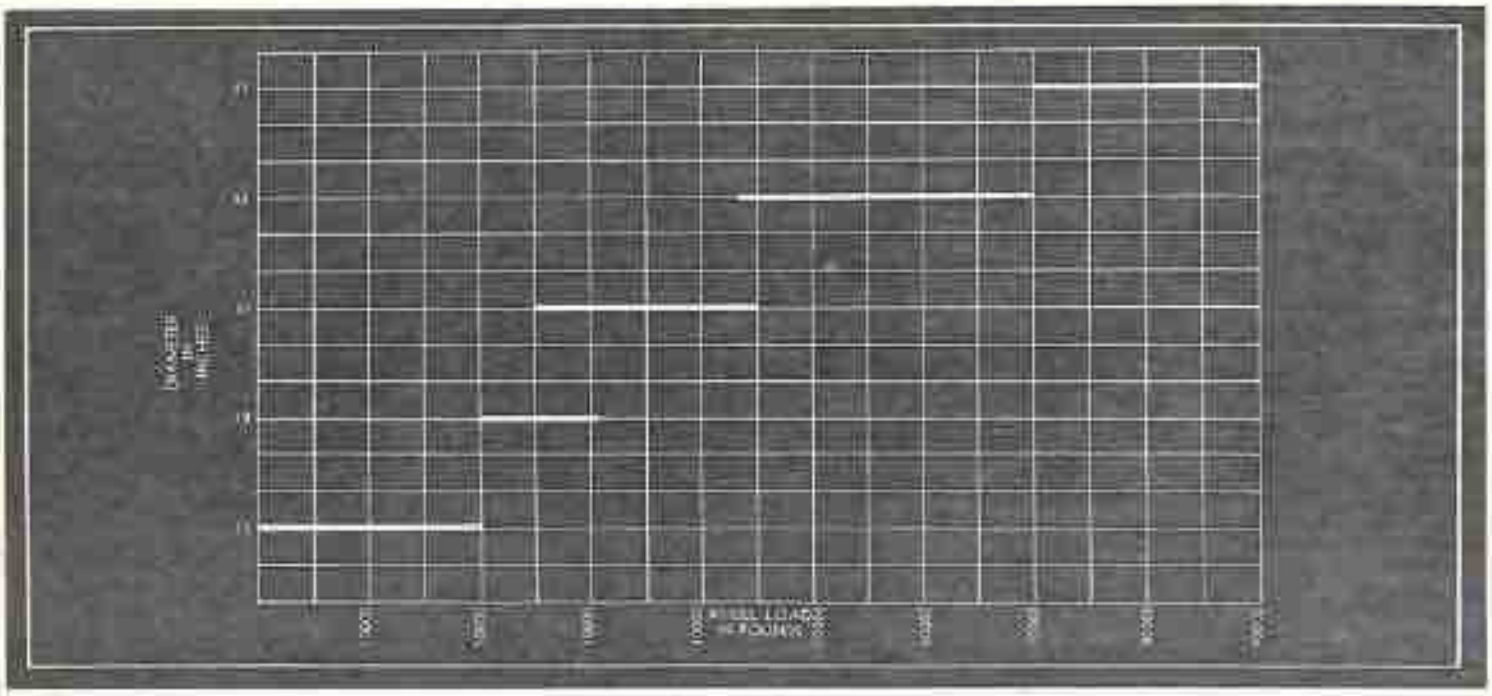
$$R_2 = \frac{WC}{E + C}$$

Maximum R_2 = 1000 ad

WHEEL SIZES

When determining diameters of crane wheels in addition to the carrying capacities of wheels, the ratio of the wheel diameter to the axle diameter must be considered. The chart below gives the range of carrying capacities of wheels in the diameters used as standard in crane building for bridge wheels.

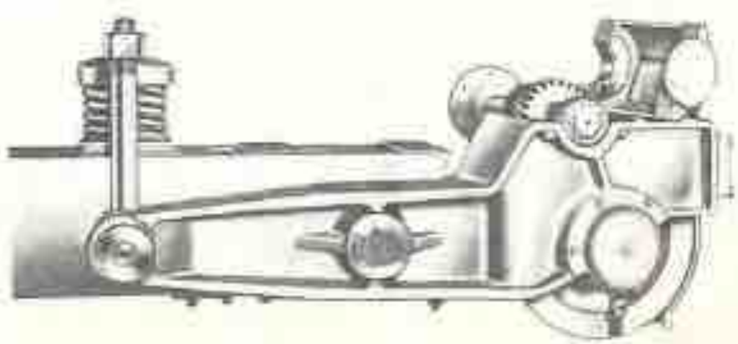
Bridge wheels come in a variety of material, including car wheel iron with chilled treads, rolled steel, forged steel, and wheels made up of iron or steel centers with steel tires of various alloys shrunk on them. (See pages 79 and 80.)



SPRING BRIDGE END TRUCK

The Spring Bridge End Truck is for use particularly on cranes having fast bridge traveling speeds operating on long runways. This truck absorbs the impacts set up when the crane passes rapidly over the rail joints that ordinarily would be transmitted to the bridge drive machinery, bearings, drive shaft and electrical equipment. In action it is identical to "Knee-Action" in the modern automobile.

As may be seen from the phantom view above, the crane girders are connected to heavy independent truck beams. Fixed in the truck beams directly beneath the end of each girder is a heavy pin. The lever arms carrying the truck wheel axles and bridge wheels rock on these pins. Heavy compression springs support the end of the lever arm and absorb any impacts set up. The wheel axles may be either the rotating type as shown, or the fixed axle type. Patent has been granted "Shaw-Box" on this truck.



TAPER TREAD TRUCK WHEELS

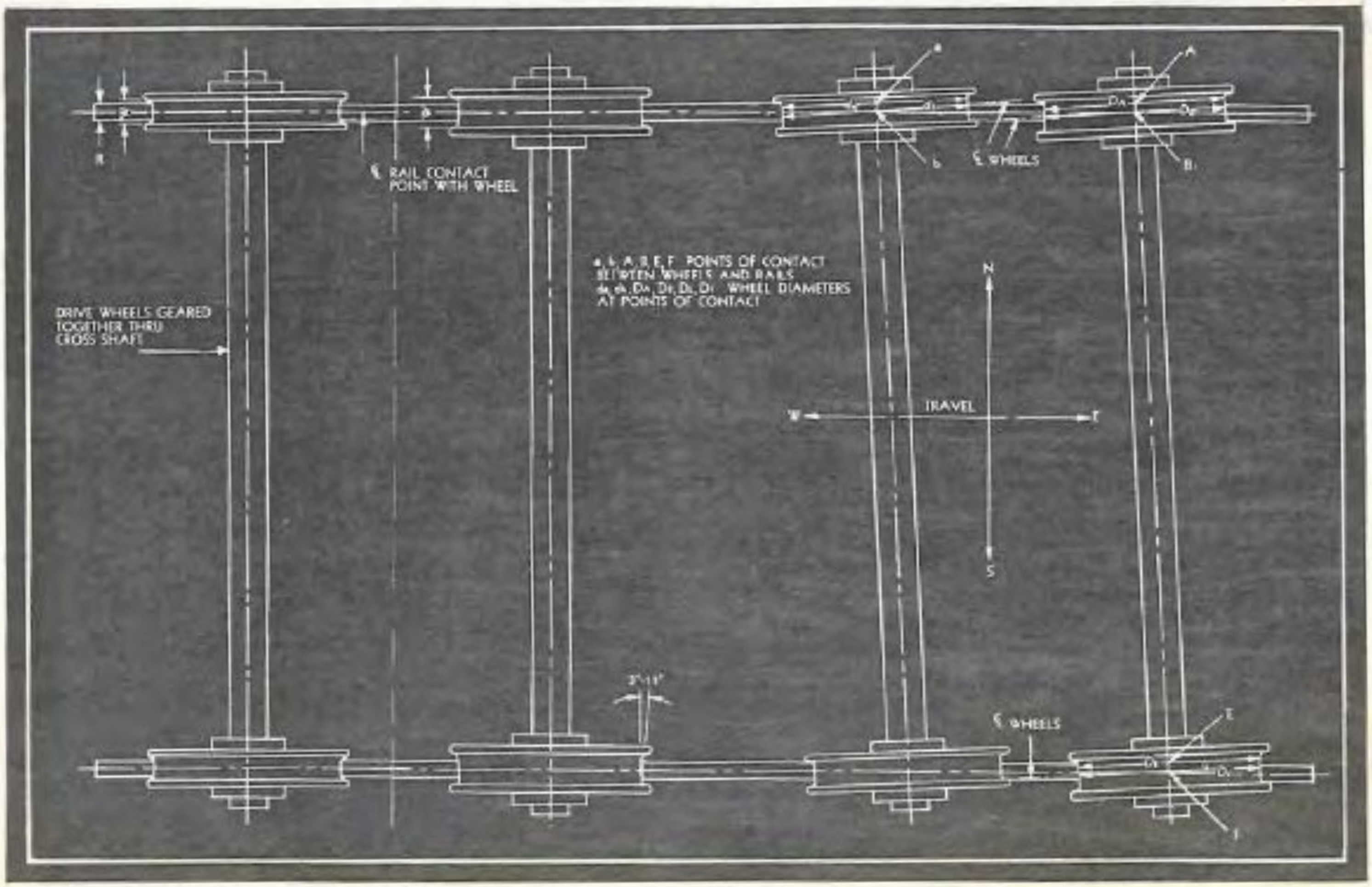
IN THE search for wheel contours and materials that will give the longest bridge wheel life on cranes, many wheel designs and materials have been utilized from time to time. The problem is twofold—one to provide a hard material of long life for the wheel treads, the other to eliminate flange wear, flange breakage, and excessive wear on the crane rails. Hard wheel materials of themselves do not solve the problem.

From much study and experimentation has come the fact that double flanged wheels having glass hard taper treads give longer life, better operation, and less wear on the crane rails than any other combination. This is because in operation, cranes equipped with taper tread wheels automatically square themselves on the runway, should they become skewed, and in operation the wheel flanges very seldom come in contact with the sides of the crane runway rails. With this condition taper tread wheels made from car wheel iron with deeply chilled glass hard treads give extremely long life.

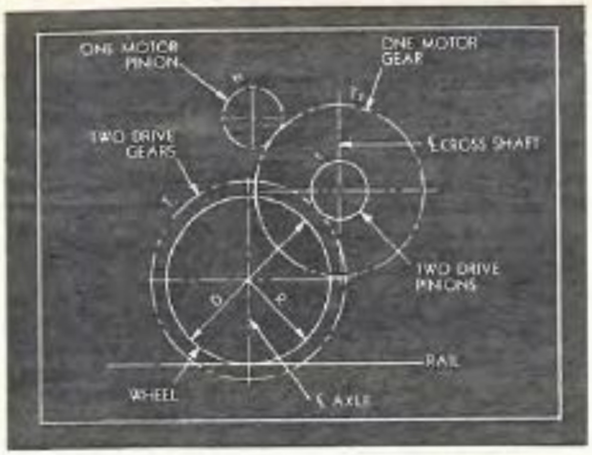
The drawing below gives the theory of operation of straight tread and taper tread wheels under normal operating conditions, and also the action of each when the crane is skewed on its track.

When a crane with straight tread wheels becomes skewed on its track, it remains in that condition until it is again squared by being bumped against the runway stops, and excessive wear on wheel flanges and crane rails takes place until the crane is again squared. If a crane with taper tread wheels should become skewed on its track, it automatically squares itself after a few feet of travel.

From the diagram below, it will be seen that if the crane were skewed on its track and began traveling west, the wheels at the north end of the crane would travel on their small diameter and those on the south end on their large diameter, the difference in travel speed being maintained until the crane assumes its proper position on the crane track. Thus it becomes self-squaring, and flange wear on the wheels is almost entirely eliminated.



SPEED REDUCTION AND GEAR RATIO



D = Wheel diameter in inches
T_1 = No. of teeth in drive gear
T_2 = No. of teeth in motor gear
t_1 = No. of teeth in drive pinion
t_2 = No. of teeth in motor pinion
r = Radius of wheel
S_M = Full load R.P.M. of motor
S_B = Bridge speed F.P.M.

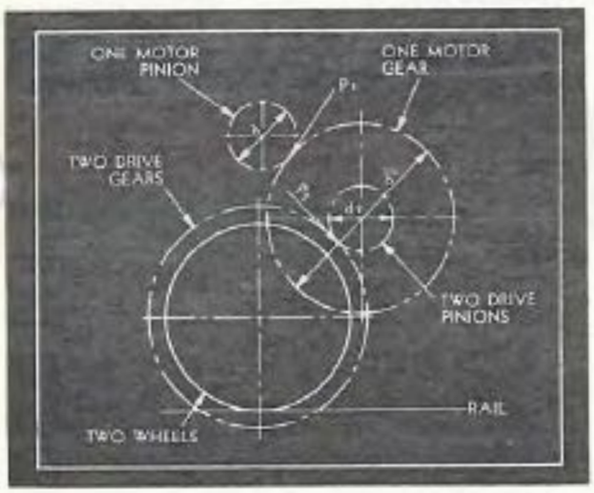
$$\text{Gear Ratio } \frac{T_1}{t_1} \times \frac{T_2}{t_2} = R$$

$$\text{R.P.M. of wheel} = \frac{S_M}{R}$$

$$S_B = \frac{D \times 3.1416 \times S_M}{12R}$$

CIRCUMFERENCES OF WHEELS	
Diameter	Circumference
10 in.	2.61 ft.
12 in.	3.14 ft.
15 in.	3.93 ft.
18 in.	4.71 ft.
21 in.	5.49 ft.
24 in.	6.28 ft.
27 in.	7.06 ft.
30 in.	7.85 ft.

LOADS ON GEAR TEETH



Assume that bridge motor torque will be 150% of normal while starting bridge, then:

$$\text{Maximum torque At motor pinion} \; \frac{1\frac{1}{2} \times 63{,}000 \times \text{H.P. of motor}}{\text{R.P.M. of motor}} = P$$

d = Pitch diameter of motor pinion in inches
d_1 = Pitch diameter of motor gear in inches
P_1 = Tooth load on motor pinion

$$P_1 = \frac{2P}{d}$$

Assume that ⅔ of torque produced in cross shaft is to be carried at either end of the bridge, then at driver pinion:

d_2 = Pitch diameter of driver pinion in inches
P_2 = Tooth load on driver pinion in pounds

$$P_2 = \frac{2P_1d_1}{3d_2}$$

SHAFTING

Normal motor torque in inch pounds =

$$\frac{63{,}000 \times \text{H.P. of motor}}{\text{R.P.M. of motor}}$$

Assume that motor will, while starting the bridge, produce 150% of the normal motor torque; and, also that ⅔ of the torque produced by the motor gear is carried by the cross shaft on either side of the motor gear, then:

$$\text{At motor gear } P_1 = \frac{1\frac{1}{2} \times \text{normal motor torque}}{\frac{1}{2}d} = \frac{3 \times \text{motor torque}}{d}$$

$$\text{Torque produced by motor gear} = \frac{P_1 \times d_1}{2}$$

$$\frac{2}{3}\left(\frac{P_1 \times d_1}{2}\right) = \frac{1}{3}\left(P_1d_1\right) = \text{twisting moment in shaft}$$

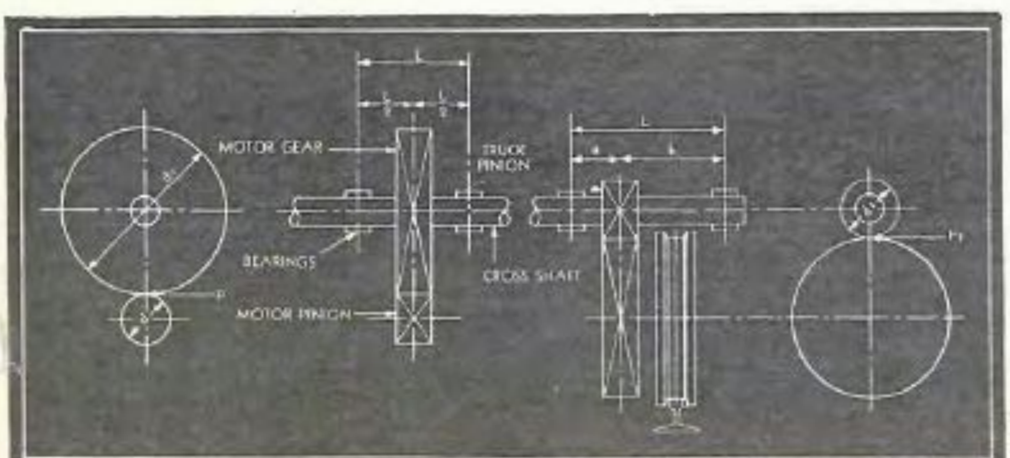
Stresses occur in cross shaft due to bending and twisting at motor gear and truck pinion. Maximum bending moments obtained as follows:

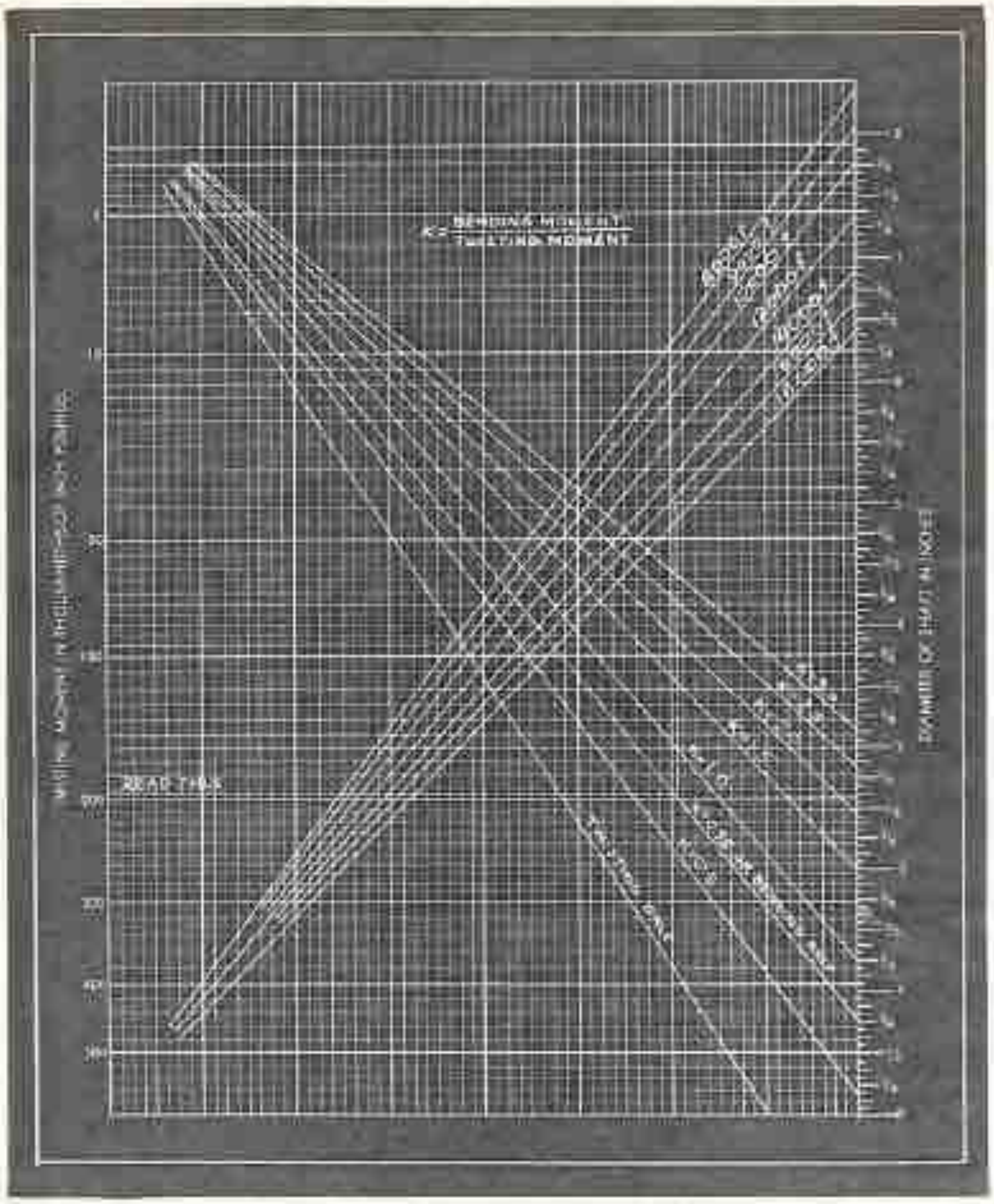
$$\text{At motor gear } \frac{P_1 \times L}{4}$$

$$\text{At truck pinion } \frac{\frac{1}{3}(P_1d_1) \times a \times b}{d_2 \times \frac{1}{2}L_1}$$

$$\frac{\text{Bending moment}}{\text{Twisting moment}} = K$$

For values of "K" see next page.





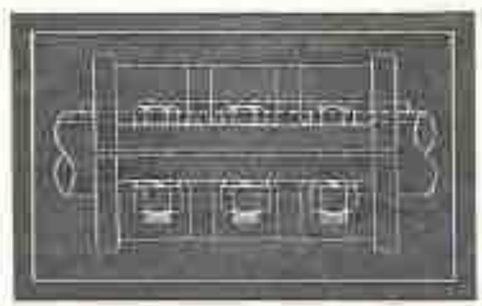
To use the chart at the right proceed as follows: Read across from the value of the twisting movement to the line nearest value of "K" required. From this point read up to the line indicating allowable fibre stress and then across to the right to obtain shaft diameter. For safety factor of 5, with open hearth steel shafting a stress of 12,000 pounds per square inch is allowable. Base formula is:

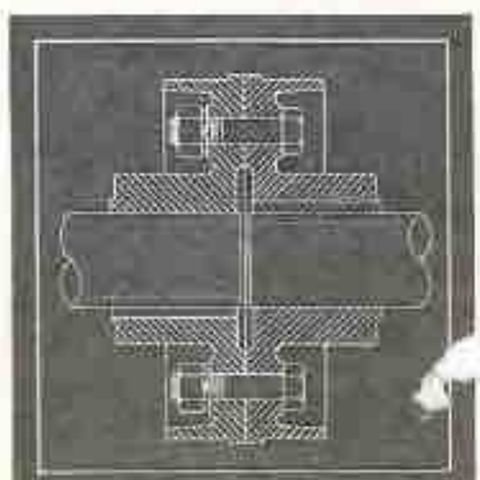
$$TE = B + \sqrt{B^2 + T^2}$$

TE = Equivalent twisting moment in inch pounds

B = Bending moment in inch pounds

T = Twisting moment in inch pounds





SHAFT COUPLINGS

Gears and pinions required on the drive shaft should be mounted on short sections of shaft to facilitate handling and maintenance. Shaft sections are joined together by couplings sufficiently strong to develop the full strength of the shaft. Drawings at the right show the clamp type coupling most commonly used, and the safety flange type coupling ordinarily used on steel mills and cranes for particularly heavy duty service.

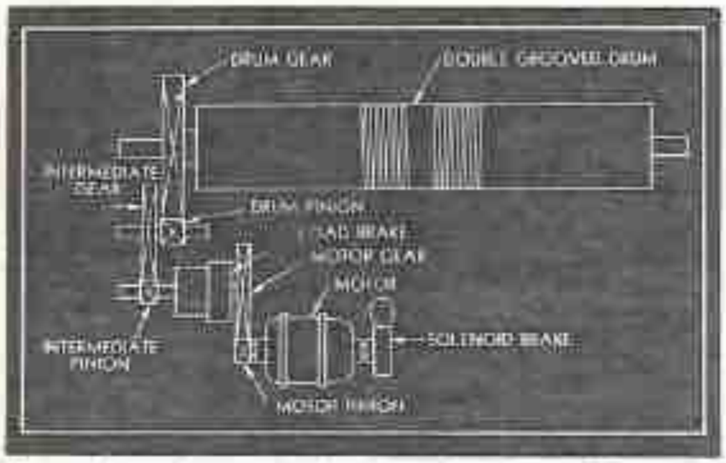
HOIST MACHINERY LAYOUTS

In order to keep weight and size of the hoisting trolley within reasonable limits, the accepted practice in crane design is to employ a combination of gearing and rope reeving to convert the motor torque and speed to "pull" at the crane hook at the speed desired.

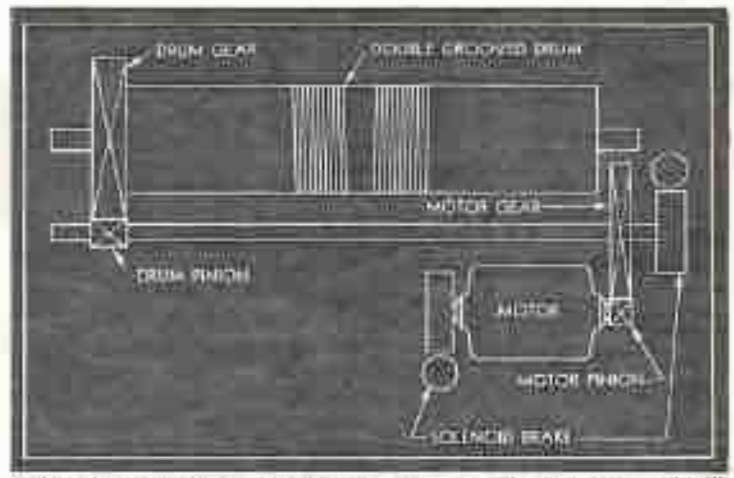
The motor torque is built up to the drum by means of gear reductions. Then utilizing the principle of the conventional tackle block, "drum pull" is multiplied by rope reeving to obtain the pull and lifting speed required at the crane hook. Load brakes are interposed in the gear train to hold and control the load. (See chapter on crane brakes.)

On small capacity cranes, it is customary to gear the drum to give a rope pull of approximately 50% of the capacity of the crane, while on cranes of larger capacity the drums are geared to give rope pulls of approximately 20% of the capacity of the crane. For example, the drum on a five-ton capacity crane would be geared to give a rope pull of 2½ tons, while on a crane of fifty-tons and greater capacity the drums would be geared to give rope pull of from eight to fifteen tons.

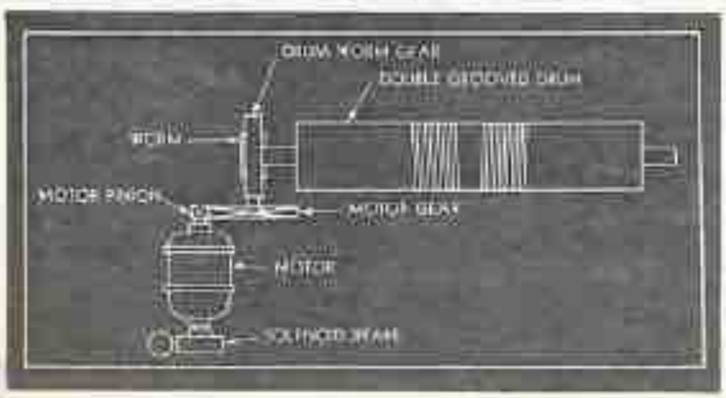
In practical application it is standard practice on cranes for industrial and steel mill service, to have all the gearing enclosed in substantial housings and operate in oil baths. On hand operated cranes or electrically operated cranes for very intermittent service, open gearing is permissible and is generally used.



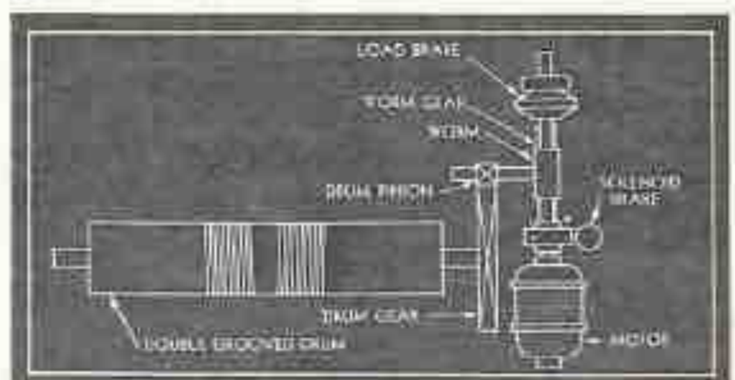
Hoist machinery layout as used on "Shaw-Box" Types "SB" and "S" cranes consisting of three reductions of spurred gears. The layout illustrated is for AC cranes. The mechanical load brakes have been employed on DC cranes or omitted, in which case dynamic braking is used.



Typical hoist machinery layout as used on moderate capacity steel mill trolleys consisting of two reductions on spur gear. Magnetic brakes are applied on motor armature shaft and on the intermediate cross shaft.



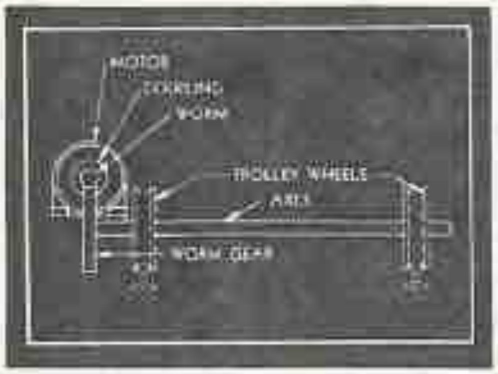
Hoist machinery layout as used on "Shaw-Box" Type "LHR" low head-room crane consisting of one reduction of spur gearing and one self-locking worm gear reduction.



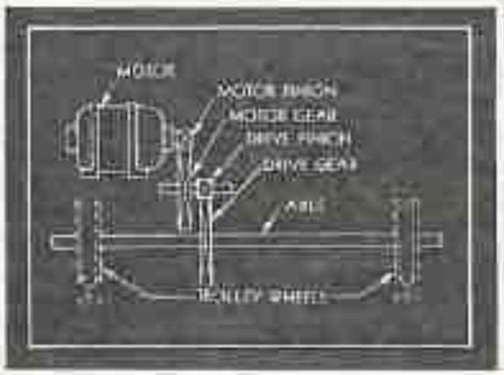
Hoist machinery unit as used on "Shaw-Box" Type "L" crane trolley consisting of one reduction of spur gearing and one non-locking worm gear reduction. Magnetic load brake is applied on the worm shaft.

TROLLEY DRIVE LAYOUTS

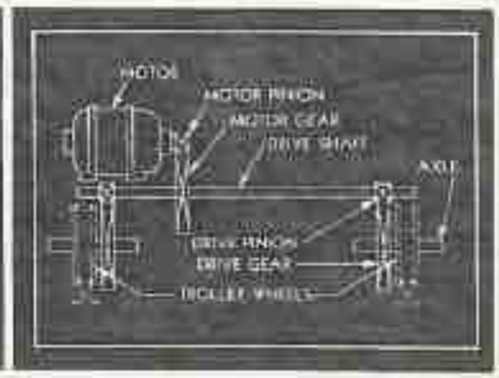
The trolley drive or traverse is the transmission of the motive power to the two trolley driving wheels, one on each side of the trolley. Spur gearing, worm gearing, or a combination of both are employed for trolley drives. The most practical and most efficient drives in general use are those shown below. Trolley drive gearing on power driven cranes for industrial service also is enclosed and operates in oil type housings. Basically, the trolley drive machinery is the same as that employed in the bridge drive of a crane.



Combined spur and worm gear trolley drive. This arrangement is used as standard on "Shaw Box" Types "LHR," "DM," and many other types of cranes. The worm gear is non locking to permit trolley to drift. Worm gear is keyed to trolley drive axle.



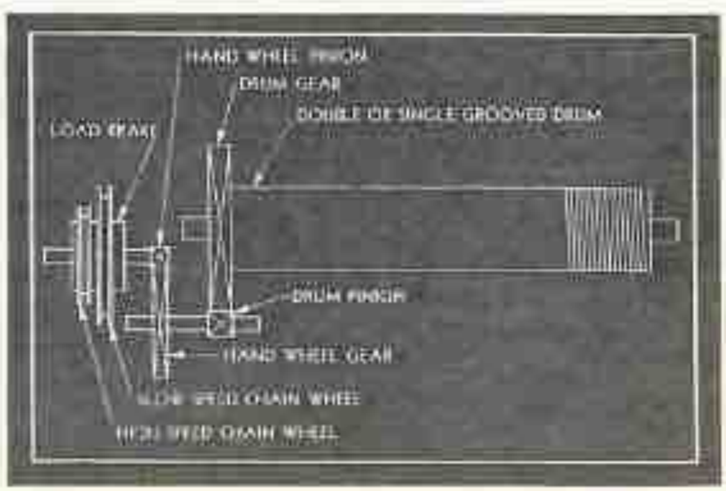
This type of trolley drive is the one most commonly used. It is standard on "Shaw Box" Types "8B," "8", and many other types. It consists of two reductions of spur gears from the motor to the trolley wheel axle. Wheels and driving gear are keyed to the axle.



Spur geared trolley drive as used on heavy capacity cranes and quite commonly used on steel mill cranes. This drive is similar to the geared type bridge drives used on cranes for industrial service.

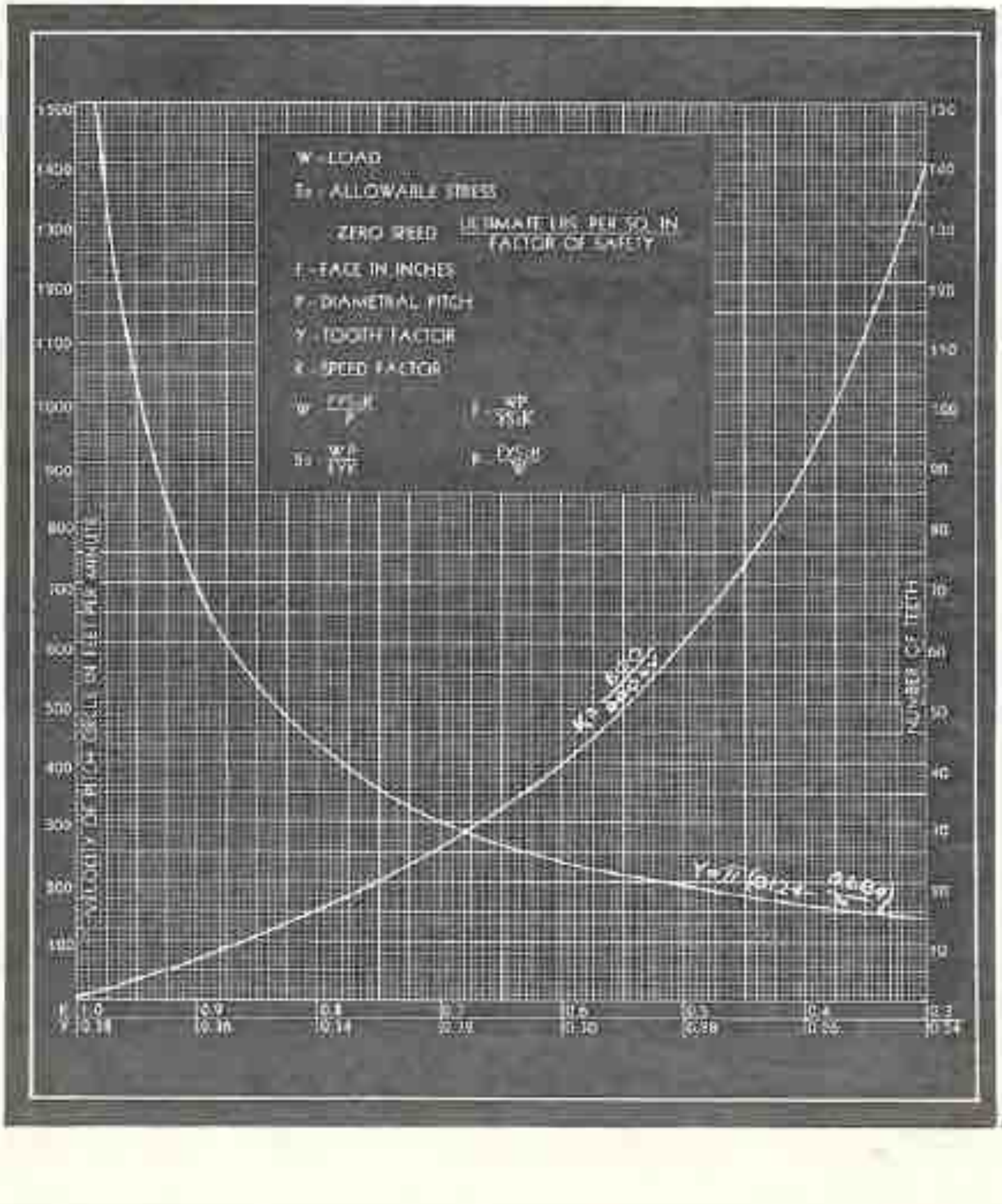
HAND OPERATED HOIST MACHINERY LAYOUTS

The hoist mechanism of hand operated cranes consists of spur gear reductions from the operating wheels (occasionally crank handles are employed to operate a hand power crane) to the winding drum with an automatic mechanical load brake interposed between the operating wheels and the winding drum. A simple, practical, and typical hand operated hoist machinery layout is shown on the drawing at the right. It is not customary to enclose the gearing of hand operated crane mechanisms. It is necessary, in hand operated equipment, to eliminate internal friction as much as possible; hence, high-grade anti-friction bearings should be used in the drum and sheaves.



THE chart on this and the preceeding page give principal strength factors, formulae, and information about 14½° involute spur gears and 20° stub tooth spur gears. Both these types are used in standard crane practice. The 14½° tooth is most generally used, though the 20° tooth, because of its characteristics, is gradually becoming more popular.

CHARACTERISTICS OF 14½° INVOLUTE SPUR GEAR TEETH



Number Teeth N	Y	Number Teeth N	Y
12	.210	19	.276
13	.226	20	.282
14	.238	22	.292
15	.245	24	.301
16	.257	26	.307
17	.263	28	.314
18	.270	30	.318

Ultimate Fiber Stresses in Pounds Per Square Inch

Heat Treated steel	100 155,000
Forged steel (.40 carbon)	80,000
Cast steel	64,000
Cast iron	32,000

Number Teeth N	Y	Number Teeth N	Y
34	.326	80	.364
38	.333	90	.367
42	.339	100	.370
46	.345	125	.373
50	.348	150	.376
60	.353	300	.383
70	.361	Rack	.389

Ultimate Fiber Stresses in Pounds Per Square Inch

Heat treated steel	100 155,000
Forged steel (.40 carbon)	80,000
Cast steel	64,000
Cast iron	32,000

BASE FORMULA

$$Y = 3.1416\left(.124 - \frac{.684}{N}\right)$$

STANDARD FACES

Diametrical Pitch	Face—In Inches
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Factors of Safety

Intermittent or standby service	4 to 5
Industrial service	5
Steel mill service	6

APPLICATION OF HOIST MOTORS

STANDARD crane practice is to use motors rated by their manufacturers on the basis of 55° Centigrade temperature rise above surrounding atmosphere with full load after the following runs:

Intermittent and standby service cranes	15 minutes
Industrial service cranes	30 minutes
Steel mill, continuous service bucket or magnet handling cranes	60 minutes

The formulae to determine the motor horsepower are below.

HOIST MOTORS

The formula to determine motor horsepower required is:

$$H.P. = \frac{W \times S}{33{,}000 \times E}$$

W = Total weight, including lower block or any other lifting appliance
S = Hoisting speed in F.P.M.
E = Over-all efficiency motor to hook or lifting appliance (see efficiencies next page)

Occasionally cranes for standby, or even very intermittent service, because of extremely high lifts at very low speeds require hoist motors rated on the same basis as continuous duty cranes.

BUCKET CRANE HOIST MOTORS

Trolleys on cranes handling two line grab buckets have two independent hoisting mechanisms, each operated by a separate motor. For this service the formula to determine the horsepower of each motor is:

$$H.P. = \frac{W \times S}{33{,}000 \times E} \times .70$$

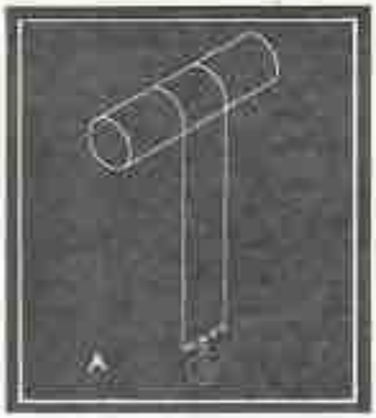
It has been determined from practical experience that it is necessary to assume that each motor must handle 70% of the total load.

TROLLEY DRIVE MOTORS

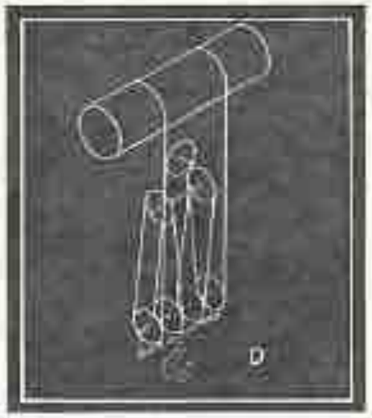
Motor horsepowers for trolley drive motors are determined by the same formula used for bridge motors (see "Bridge Drive Machinery," motors and gearing). For trolley motors value used for "E" should be .85 when two gear reductions are used, and .75 when three gear reductions are used.

ROPE REEVING

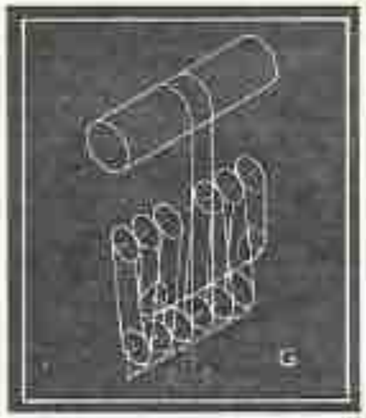
The drawings below show the various methods of reeving ropes to multiply drum pull and effect speed reduction. In all cases, both ends of the rope are anchored to the winding drum. The tables give the efficiency of each style of reeving, and also the overall efficiency between the source of power and the load hook when one, two, three, or four gear reductions are employed and when roller or bronze bearings are used in the construction.



Direct Lift Whip Style Reeving.—Both ends anchored to the drum.

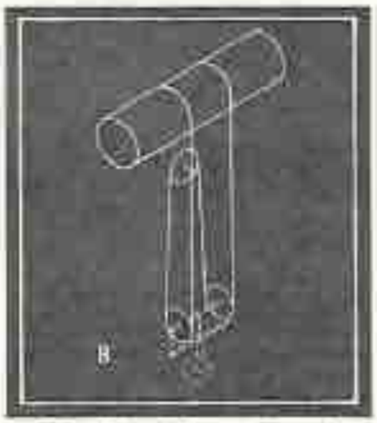


Eight Parts of Rope.—Four part double reeving, two ends anchored to the drum.

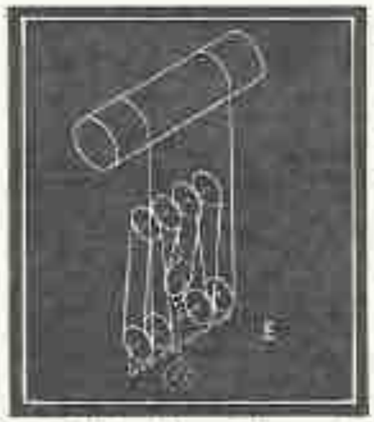


Fourteen Parts of Rope.—Seven part double reeving, two ends anchored to the drum.

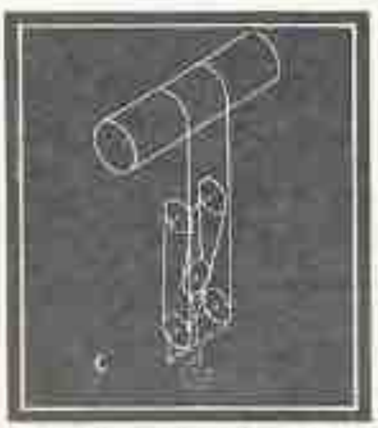
Sixteen Parts of Rope.—Eight part double reeving, two ends anchored to the drum.



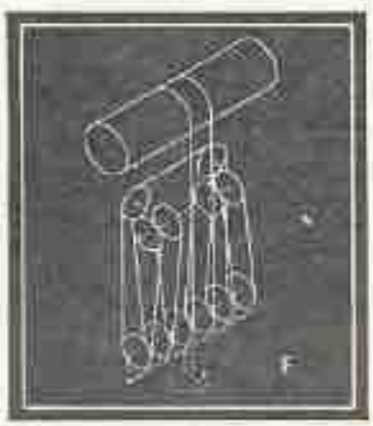
Four Parts of Rope.—Two part double reeving, two ends anchored to the drum.



Ten Parts of Rope.—Five part double reeving, two ends anchored to the drum.



Six Parts of Rope.—Three part double reeving, two ends anchored to the drum.



Twelve Parts of Rope.—Six part double reeving, two ends anchored to the drum.

OVERALL EFFICIENCY

NUMBER OF GEAR REDUCTIONS WITH ROLLER BEARINGS

Reeving	Efficiency Block to Drum	Gear Reduction 14½° Involute				Gear Reduction 20° Stub				Lead Line Factor
		1	2	3	4	1	2	3	4	
A	.98	.93	.885	.84	.80	.95	.92	.895	.87	
B	.96	.91	.87	.82	.78	.93	.90	.88	.85	.52
C	.945	.90	.85	.81	.77	.915	.89	.865	.835	.353
D	.92	.875	.83	.79	.75	.89	.865	.84	.815	.271
E	.905	.86	.82	.775	.74	.88	.85	.825	.80	.221
F	.885	.84	.80	.76	.72	.86	.83	.81	.78	.188
G	.86	.82	.78	.74	.70	.835	.81	.785	.76	.166
H	.845	.80	.765	.725	.68	.82	.795	.77	.75	.148

NUMBER OF GEAR REDUCTIONS WITH BRONZE BEARINGS

Reeving	Efficiency Block to Drum	Gear Reduction 14½° Involute				Gear Reduction 20° Stub				Lead Line Factor
		1	2	3	4	1	2	3	4	
A	.955	.89	.835	.75	[illegible]	.915	.87	.83	.79	
B	.935	.87	.80	.74	.69	.90	.85	.81	.77	.53
C	.925	.85	.78	.72	.66	.88	.830	.79	.75	.364
D	.90	.83	.77	.70	.64	.855	.81	.77	.73	.278
E	.875	.805	.74	.68	.62	.83	.79	.75	.71	.228
F	.855	.79	.72	.67	.61	.81	.77	.73	.69	.19
G	.83	.765	.70	.65	.59	.79	.75	.71	.675	.172
H	.80	.74	.68	.62	.57	.76	.73	.695	.65	.156

$$\text{Pull on one lead line (block to drum)} = \frac{\text{Total load} \times \text{Lead line factor}}{E}$$

WIRE ROPE

The wire ropes used on the cranes must be flexible and for that reason the rope used is termed 6 x 37 to indicate the make up, which means six strands with thirty-seven wires to each strand with a hemp center. For certain requirements, 6 x 19 rope is used, but in that case to obtain long life it is necessary to increase the ratio of the drum and sheave diameter to the rope. Below are tabulations giving the number of parts and sizes of ropes usually used for the different service classifications for cranes, as well as the breaking strength of the wire ropes as manufactured by prominent wire rope makers.

NUMBER OF PARTS AND SIZES OF ROPES FOR CRANES

CAPACITY	SERVICE CLASSIFICATION					
	INTERMITTENT AND STANDBY		INDUSTRIAL		STEEL MILL	
	Parts	Diameter Inches	Parts	Diameter Inches	Parts	Diameter Inches
3	3	⅜	4	⅜	4	7/16
			4	7/16		
5	3	7/16	6	⅜	4	½
			4	½		
7½	4	½	4	9/16	4	⅝
10	4	9/16	8	7/16	6	⅝
			4	⅝	4	¾
15	6	½	8	9/16	6	¾
			10	½		
15			6	⅝	4	⅞
20	6	⅝	8	⅝	6	⅞
20					8	¾
25	8	⅝	8	⅝	6	1
			8	¾		
25			10	⅝	8	⅞
					10	¾
30	10	⅝	10	⅝	8	⅞
			10	¾		
30			8	¾	10	⅞
40	10	¾	12	¾	10	1
50	12	¾	12	¾	12	1
60	10	⅞	10	1	12	1⅛
75	10	1	12	1	14	1⅛
100	12	1	12	1¼	16	1¼
125	12	1⅛	14	1¼	20	1¼
150	14	1¼	16	1⅜	20	1⅜
200	16	1¼	24	1⅜	24	1⅜

BREAKING STRENGTH OF WIRE ROPES

Diameter Inches	Weight Per Foot	BREAKING LOAD IN TONS				
		Plow Steel 6 x 37	Roebling "Blue Center" 6 x 37	Leschen "Hercules" 6 x 37	American Steel and Wire "Monitor" 6 x 37	MacWhyte "Monarch" 6 x 37
¼	.10	2.4	2.8	2.8	2.8	2.8
5/16	.16	3.8	4.4	4.4	4.4	4.4
⅜	.22	5.3	6.1	6.1	6.1	6.1
7/16	.30	7.2	8.3	8.3	8.3	8.3
½	.39	9.2	10.6	10.6	10.6	10.6
9/16	.49	11.5	13.2	13.2	13.2	13.2
⅝	.61	14.0	16.1	16.1	16.1	16.1
¾	.87	19.8	22.8	22.8	22.8	22.8
⅞	1.19	26.5	30.5	30.5	30.5	30.5
1	1.55	34.4	39.5	39.5	39.5	39.5
1⅛	1.96	43.5	49.9	49.9	49.9	49.9
1¼	2.42	53.5	61.5	61.5	61.5	61.5
1⅜	2.93	64.6	74.3	74.3	74.3	74.3
1½	3.49	76.7	88.2	88.2	88.2	88.2

CRANE RUNWAYS

ON THIS and the following pages are typical designs of crane runways. These show the variations that are used for supporting the crane runway to building columns to support cranes for different service conditions that exist.

Basically, there are three types of crane runways: one for top running cranes supported from the building structures; the second for underhung cranes supported from the overhead roof trusses or ceiling; and the third, runways for cranes for outdoor service supported on "A" frames mounted on concrete foundations set in the ground.

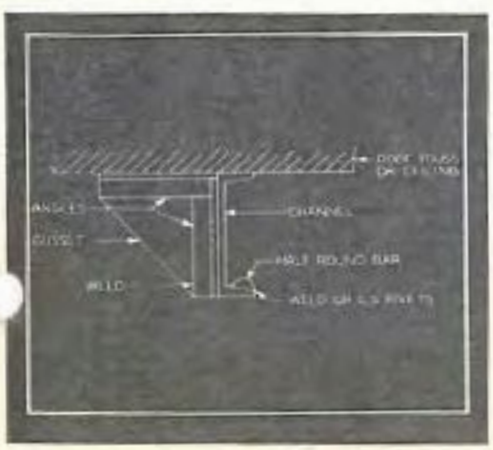
Common to all types, to insure successful crane operation, is the necessity that the span for the crane be maintained accurately within close limits the entire length of the runway, the joints of all rails to be accurately made to eliminate gaps between the rails, and the runway rails be level the entire length of the track.

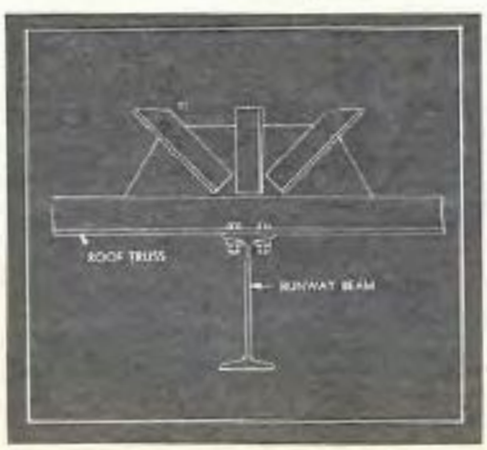
It is also very important that the runway rail be of proper section to withstand the maximum wheel load of the crane.

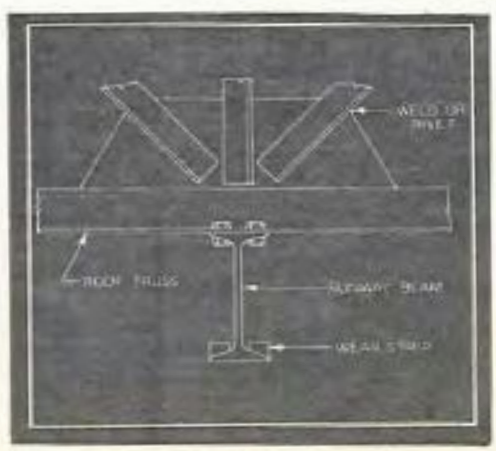
Sizes of crane rails that are used on crane runways and crane bridges, together with typical methods of fastening are shown on page 67.

RUNWAYS FOR UNDERHUNG CRANES

Below are drawings of three popular types of crane runways for underhung cranes. The most popular for average service conditions is that shown in the second drawing. The drawing at the right shows typical runway for underhung cranes of heavy capacity or cranes operating continuously at high speed, as well as high speed heavy duty mono-rail hoists. The drawing at the left shows a type of runway frequently used when headroom conditions are very limited and it is necessary to locate the crane as close to the nearest overhead obstruction as is possible.



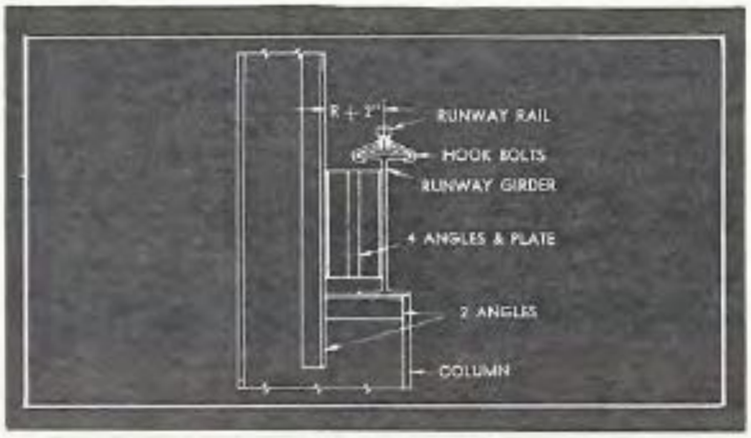




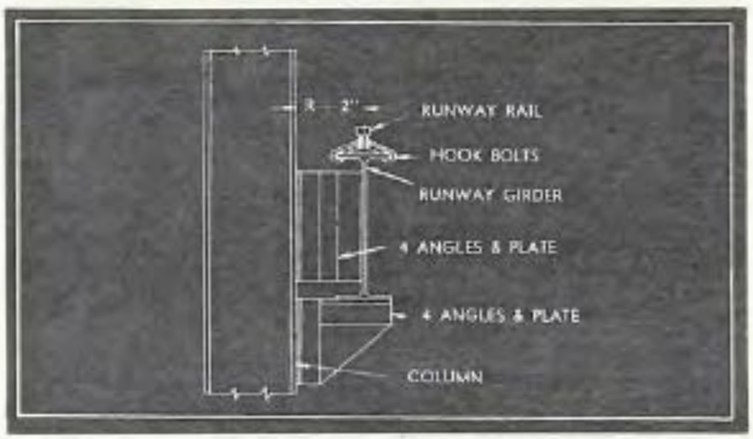
CRANE RUNWAYS AND STOPS

The drawings on this and the following page show typical methods of supporting crane runway girders to the building columns and attaching rails to the runway.

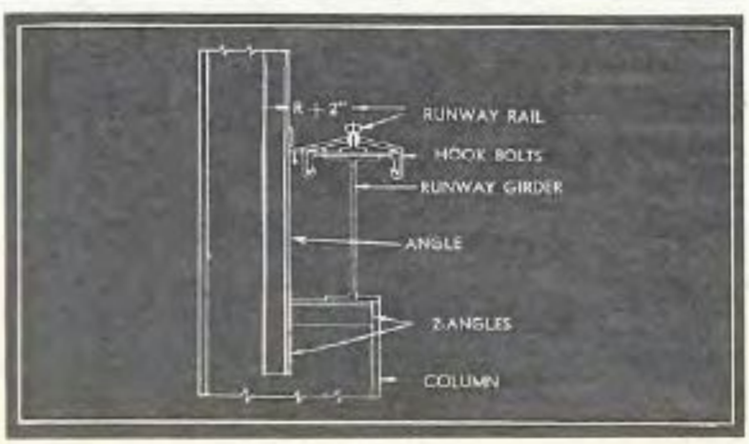
The size and type of the runway girders are determined by figuring the maximum bending moments imposed by the crane, considering the maximum wheel load imposed by the crane as the maximum loading. In calculations, provision must be made for impact and thrust as covered by the formula for determining maximum wheel loads. The construction illustrated by the drawings is based on welded construction, though the same design exactly is followed when fabrication is by the riveting process.



At the left is illustrated the design of a runway for hand operated or electrically operated cranes of moderate capacity, and consists of supporting brackets attached to the building columns and with a web construction between the runway girder an the building column. Rails may be attached to the runway girder by welding or rail clamps, instead of the hook bolts as illustrated.

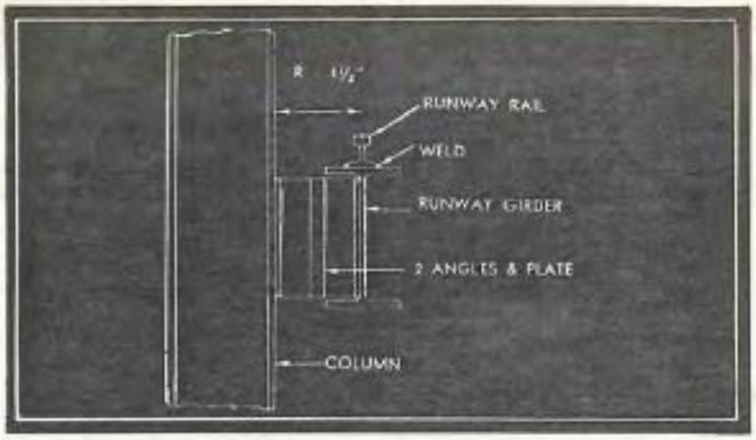


At the left is illustrated typical column connection and runway girder construction as used for electric traveling cranes for industrial or continuous duty service. Building columns are constructed to provide seats for the runway girders. Rails may be attached to the runway girder by welding or rail clamps, instead of the hook bolts as illustrated.

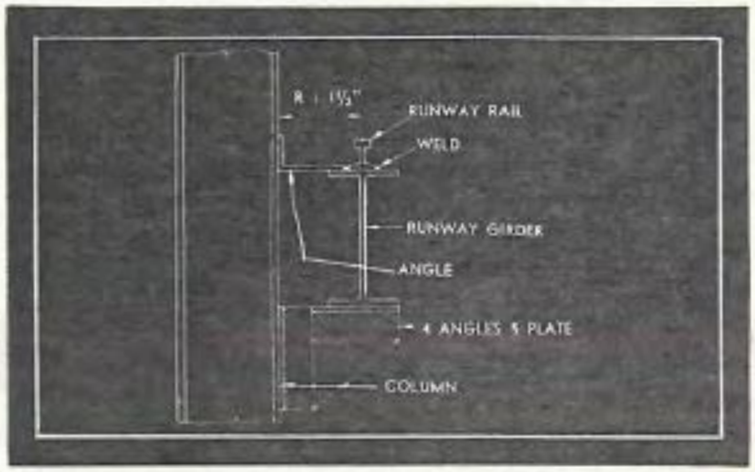


At the left, column and runway construction for electrical traveling cranes, for heavy duty industrial cranes, or cranes for continuous duty. The type of girder construction illustrated is used to provide additional lateral stiffness to the runway. Rails may be attached to the girder by welding or rail clamps, instead of the hook bolts as illustrated.

At the right is illustrated an inexpensive type of runway construction commonly employed for light capacity hand operated and electrically operated cranes. This construction consists of supporting the runway girder from the building columns by means of a web connection. Connection between the runway girder and building columns may be by welding, as illustrated, or by riveting or bolting. Rail may be attached to the runway girder by hook bolts or rail clamps.



At the right, typical runway construction for intermittent duty and standby cranes of moderate capacity. The runway girders are supported on brackets attached to the building columns, and an additional tie at the top of the runway girder is employed. Rails may be attached to the girder by hook bolt or rail clamps, instead of welding, if desired.

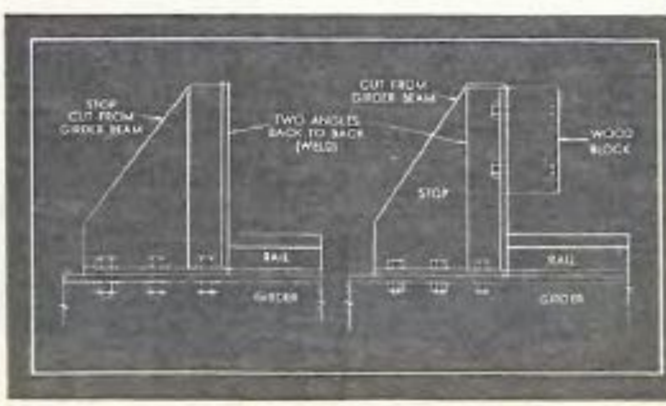


At the right, this drawing illustrates the use of rail clamps for fastening rails to crane runway girders. The use of clamps, however, necessitates the drilling of the girder to receive the bolts for the clamps. Clamps are made from either malleable iron, cast steel, or drop forgings, dependent upon the service required.

RAIL ATTACHED TO GIRDER WITH RAIL CLIPS

RUNWAY RAIL STOPS

At the right are illustrated simple effective rail stops for the ends of crane runways made up of standard structural sections. Stops should always be attached to the girder, not to the crane runway rails. Frequently, for certain conditions, spring bumpers similar to those shown in bottom illustration on page 67 are also used for crane runways.



CRANE BRAKES

IN ORDER to provide for the utmost in safety and delicacy of control in hoisting and load carrying machinery, it is of utmost importance that the load be under perfect control of the operator at all times.

To accomplish this, over the years many devices electrically, mechanically, and hydraulically operated have been developed for holding and controlling loads. Braking methods and mechanisms have been the subject of much study and research by the engineering profession since the beginning of mechanical load handling.

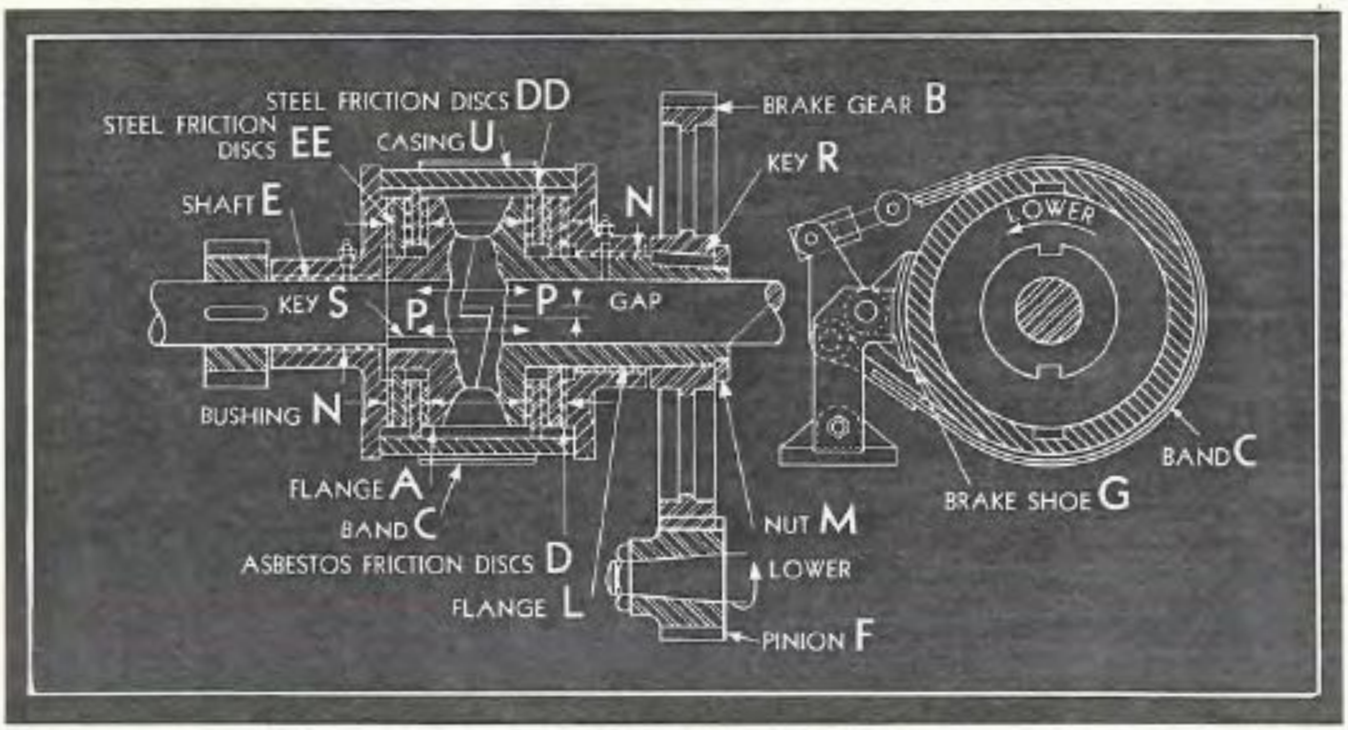
The function of brakes is to hold and control the movement of loads under all conditions. At present, three primary methods are employed: mechanical, electrical, and hydraulic. The selection of the braking system best suited for each specific application depends upon the type of function the mechanism must perform in connection with the service it must deliver. In this section are illustrated and described braking devices that are representative of the most modern trend in brake design. Each of them thoroughly proved by many years of service under the most rigorous conditions.

It has been established, as a principle, that the brakes in the hoisting mechanism must be automatic —not dependent in any way upon the crane operator. And, to promote safety and give utmost accuracy of control, there should be two braking systems on each hoisting mechanism of electrically operated cranes properly coordinated and working in conjunction, one with the other. One braking system consists of an automatic electrically operated brake at the source of power (motor) and an automatic mechanical load brake interposed in the mechanism between the winding drum and the source of power. This combination is considered standard practice on cranes operated by alternating current motors. The other system consists of an automatic electrically operated brake at the source of power (motor) and the utilization of dynamic or regenerative braking to control the lowering speed. This combination is generally used on cranes with direct current motors up to 25-ton capacity. This same combination, plus an additional automatic electrically operated brake, designed particularly for the purpose, and interposed between the winding drum and the source of power, is generally used on direct current cranes of over 25-ton capacity.

On cage controlled cranes, the bridge travel brake is not automatic, but is applied by the operator by means of a foot pedal located in the cage. The most modern, as well as the most satisfactory bridge brake, is a hydraulically operated one.

It is not standard practice to employ brakes on the bridge travel motion of floor controlled cranes except that quick stopping and limitation of crane drift is necessary. There are two types of brakes available for floor controlled cranes. One is an automatic electrically operated brake of the same design as used on the hoist mechanisms except with less holding power, usually one-half of the motor torque —the other is the hydraulic brake as used on cage controlled cranes except that it is applied by pulling on a pendant cord hanging to within easy reach of the ground. Except for unusual requirements, no brakes are applied to the trolley travel motion of cranes.

SELF-CONTAINED SHAW-BOX TYPE "S" MULTIPLE DISC MECHANICAL LOAD BRAKE



Pressure on the friction discs of this brake is extremely low. Friction discs are iron with ground surfaces and asbestos composition. No adjustment is required.

OPERATION

When the motor is started in the hoisting direction it revolves the brake gear "B" keyed to flange "L," and as a result of the thrust "P" set up by the helix on flange "L," all parts of the brake are locked together and the entire unit revolves, turning shaft "E." Simultaneously, the one-way differential holding brake band "C" automatically releases.

When the motor is stopped, the load, acting on shaft "E" (the brake still being locked together), begins to rotate the entire unit in the opposite direction. Instantly the one-way differential holding band "C" grips the brake casing "U" and prevents it from turning, and thus the load is held.

During lowering the casing "U" is prevented from turning by the holding band "C." When the motor is started in the lowering direction brake gear "B," which is keyed to flange "L" which floats on shaft "E," tends to release the helix. This reduces pressure "P" between friction discs "D" and "DD." The load rotates shaft "E" to which flange "A" is keyed tending to tighten the helix as fast as the motor releases it, thus maintaining sufficient thrust "P" to lower the load at a constant speed. When lowering without load, helix gap is closed entirely and there is a direct drive between gear "B" and shaft "E" without any thrust "P."

Discs "DD" are keyed to the casing "U." Discs "EE" are keyed to flanges "A" and "L." Discs "D" are free to turn.

SINGLE DISC ROLLER RATCHET TYPE

This is a type of brake employed on worm-driven hoist units when a non-locking worm is employed. It is essentially a free-wheeling device being applied in the lowering direction only by the thrust of the worm. The power is not transmitted through the brake, as in other load brakes, either during the hoisting or the lowering operation. Brake operates in an oil bath and the friction disc is an asbestos composition.

The illustration shows the application of this brake, identified as "Shaw-Box" Type "L," to a worm-driven hoisting unit. Notice the radiating fins on the end of the housing to assist in quickly dissipating the heat.

OPERATION

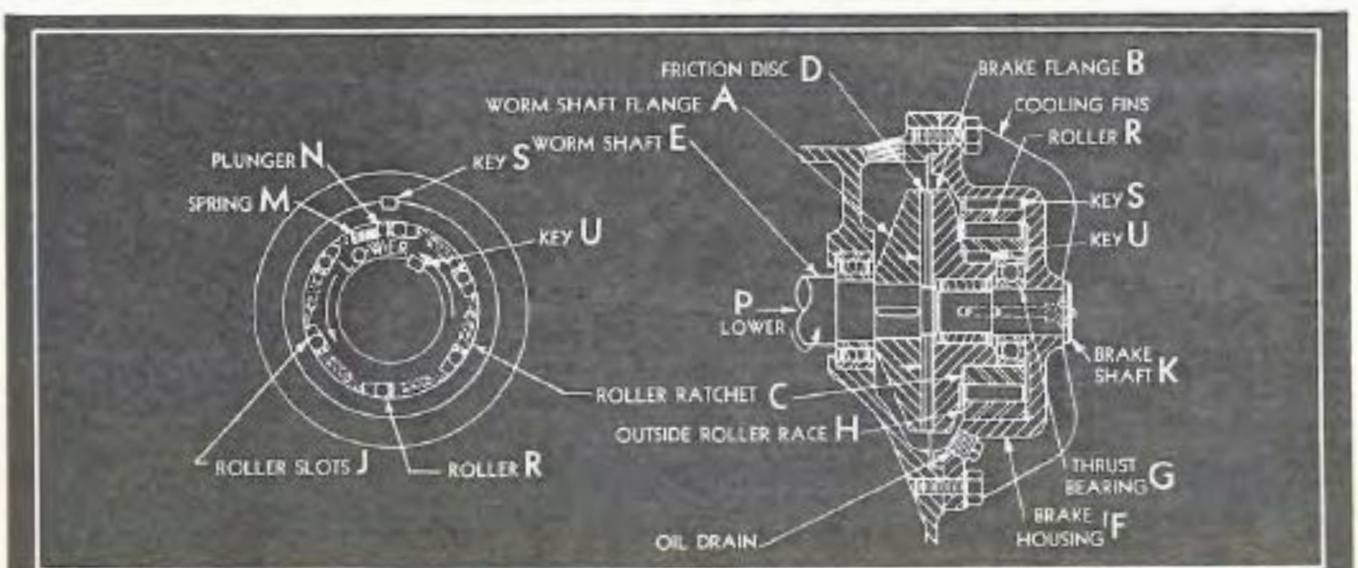
When the motor is started in the hoisting direction worm shaft flange "A," friction disc "D," and brake flange "B" all rotate together as a single unit.

When the motor is stopped the load acting on the worm shaft to which flange "A" is keyed (the brake still being locked together) begins to rotate the entire unit in the opposite direction. Instantly the rollers with the assistance of the plunger "N" and the spring "M" move in their slots "J" and brake flange "B" is prevented from turning, and thus the load is held.

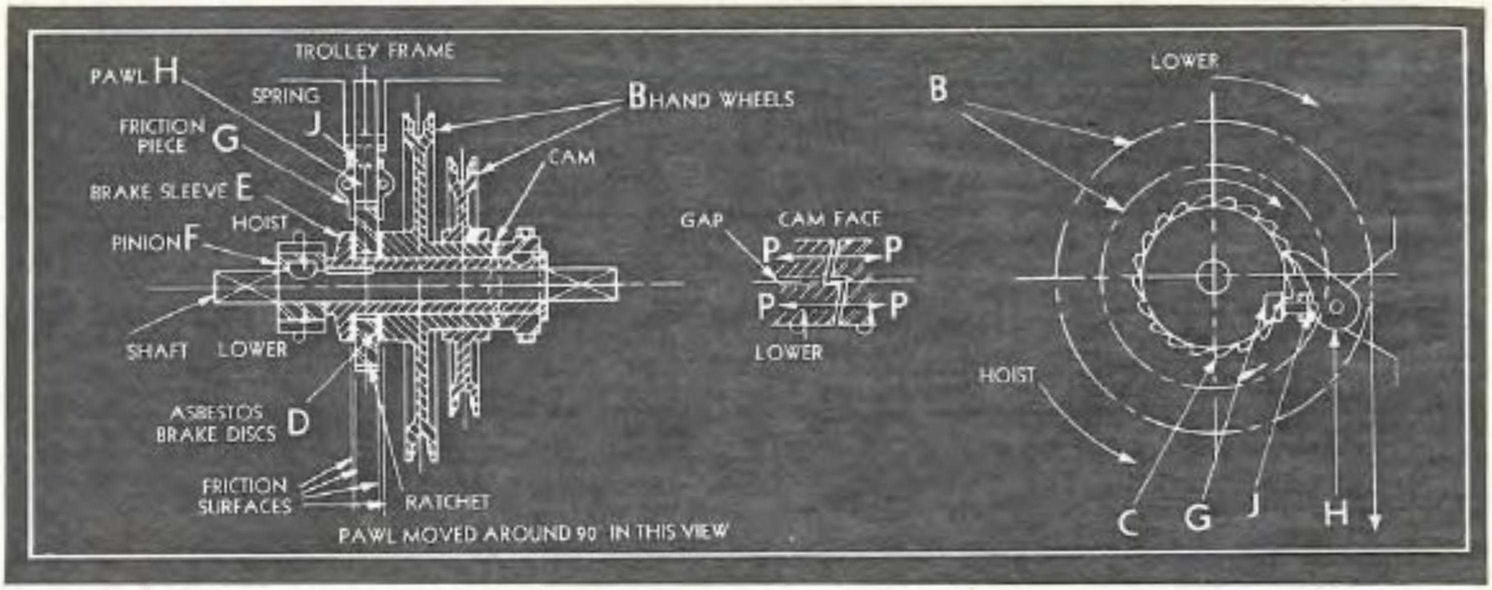
During lowering the brake flange "B" is prevented from turning by the roller ratchet.

When the motor is started in the lowering direction, the load acting on the worm shaft tends to overhaul the speed of the motor. The thrust of the worm shaft sets up pressure "P" between flange "A," friction disc "D," and brake flange "B" sufficient to maintain a constant lowering speed.

When lowering without load no pressure is set up between "A," "B," and "D."



BRAKES FOR HAND OPERATED CRANES AND HOISTS



THE drawing above shows the silent ratchet double disc mechanical load brake as applied to hand operated mechanisms. This same arrangement is employed in the construction of chain blocks. The two hand chain wheels are used on hand operated cranes to give two speeds of hoisting and lowering so that the empty hook may be handled more rapidly than the full load.

OPERATION

When the hand chain is pulled in the hoisting direction, the hand wheels "B" are free to turn on the brake sleeve "E," and as a result of the thrust set up by the cam all parts of the brake are locked together and the entire unit operates shaft to which is keyed pinion "F."

When the pull is released from the hand chain the load acting on pinion "F" (the brake still being locked together) begins to rotate the entire unit in the opposite direction. Instantly the pawl engages the ratchet wheel and prevents it from turning. Thus, the load is held.

During lowering ratchet wheel "C" is prevented from turning by pawl "H." When the hand chain is pulled in the lowering direction the hand wheels which float on brake sleeve "E" tend to release the cam. This reduces the pressure between brake sleeve "E" friction disc "D," ratchet wheel "C," and the hub of the chain wheel. The load rotates pinion "F" keyed to the same shaft as brake sleeve "E" tightens the cam as fast as the pull on the hand chain releases it. Thus, sufficient pressure is maintained to lower the load at a constant speed.

When lowering without load the cam gap is closed entirely and there is a direct drive between hand chains "B" and pinion "F" without any thrust or pressure.

Friction pieces "G" are used to hold pawl "H" out of contact with ratchet "C" to eliminate noise. They do not affect the operation of the brake.

GENERAL

All of the mechanical load brakes illustrated on the foregoing pages, with the exception of the Type "L" brake, employ what is termed the "Weston" principle and as a result are commonly known as "Weston" type brakes. The principle employed revolutionized brake design, because with it power is transmitted through the brake, without any initial friction in the hoisting direction, and the friction set up in the brake during the lowering direction is in direct proportion to the load being handled. In operation, it requires approximately the same amount of power to lower the load being handled as it does to raise it.

DYNAMIC AND REGENERATIVE BRAKING

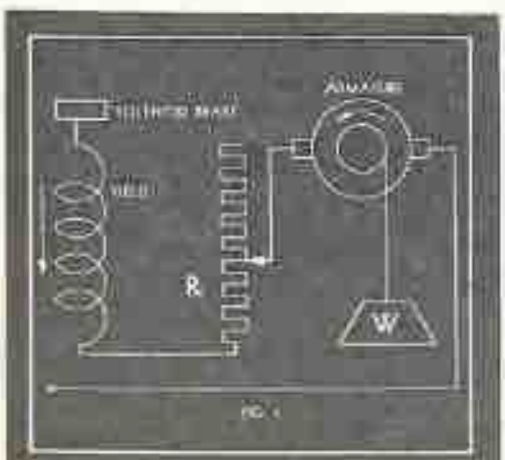
ON CRANES operated by Direct Current it is standard practice to utilize the magnetic brake to stop and hold the load, and the dynamic lowering system to control the speed of lowering. Basically, the dynamic lowering system is the change of the operating characteristics of the hoist motor, in the lowering direction only, first to that of a shunt machine, and then to that of a generator. This changeover is made by electrical connections in the controller. The wiring diagrams below illustrate the transition.

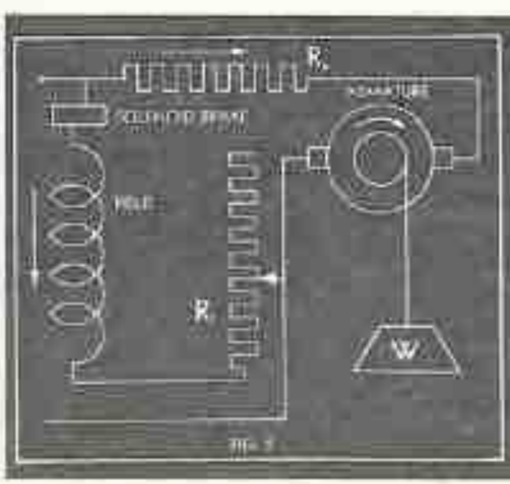
During hoisting, the motor armature, field, brake, and resistance "Rf" are connected in series as shown in Figure 1. On the first point of the controller approximately one-half of full load current flows through the circuit. This is sufficient to release the brake and start the average load. On succeeding points of the controller the resistance is cut out to bring the motor to full speed.

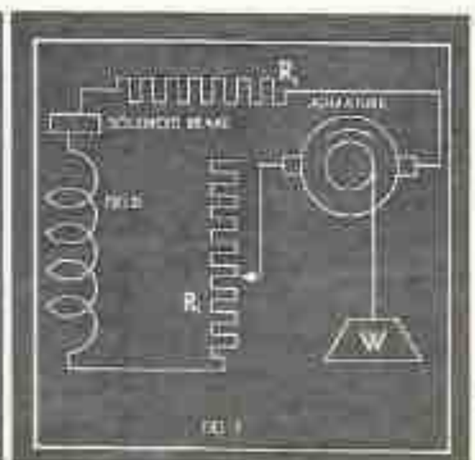
When the controller is operated in the lowering direction, the motor is changed over to a shunt machine as shown in Figure 2 by connecting the series field, series brake, and speed regulating resistance "Rf" in parallel with the armature and the fixed armature resistance "Ra." The resistance "Rf" limits the flow of current through the series field and controls the speed. Now the flow of current through the series field is in the same direction as when hoisting, and through the armature and fixed resistance "Ra" in the opposite direction to that taken in hoisting.

Because of this, the armature takes current from the line and operates as a motor in the lowering direction only as long as the load does not overhaul it. If the load is heavy enough to overhaul the motor, then the motor speeds up and its back e.m.f. increases until it operates as a generator and acts as a brake. The current through the armature now reverses and the machine is self-exciting so that it could be disconnected from the line as shown in Figure 3. The lowering speed is controlled by the resistance "Rf." In this condition the motor could be disconnected from the power supply and the load would continue to descend under absolute control as long as the controller was in the lowering position. If, however, the controller were thrown to the "off" position, and the load stopped, the load could not be started until the crane was again connected to the power supply because the magnetic brake would not release.

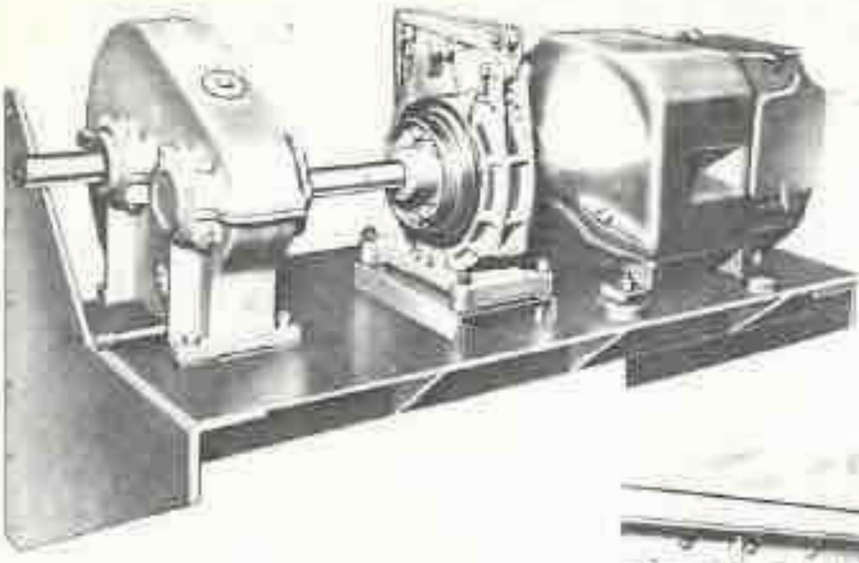
Since the resistance of the series field and brake is low, the lowering speed on the first point of the controller is slow. On each succeeding point of the controller the resistance "Rf" in the dynamic braking circuit is increased and the full speed lowering position is reached when all the controlling resistance has been inserted. Thus, the motor acts as a retarding means whenever the load tends to overhaul it, and has the characteristics of a shunt motor wherever the load is not sufficiently heavy to overhaul it.





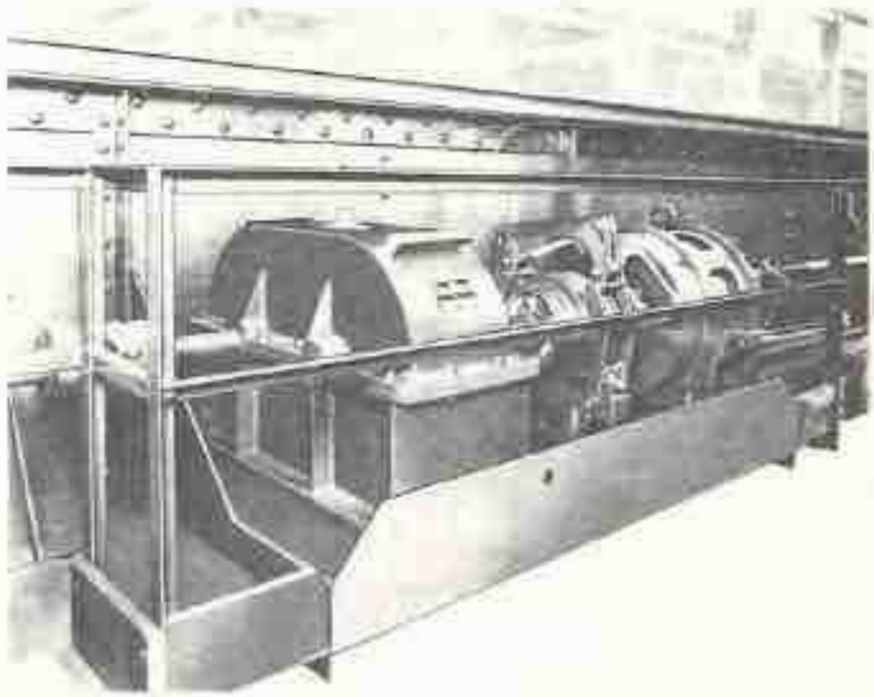


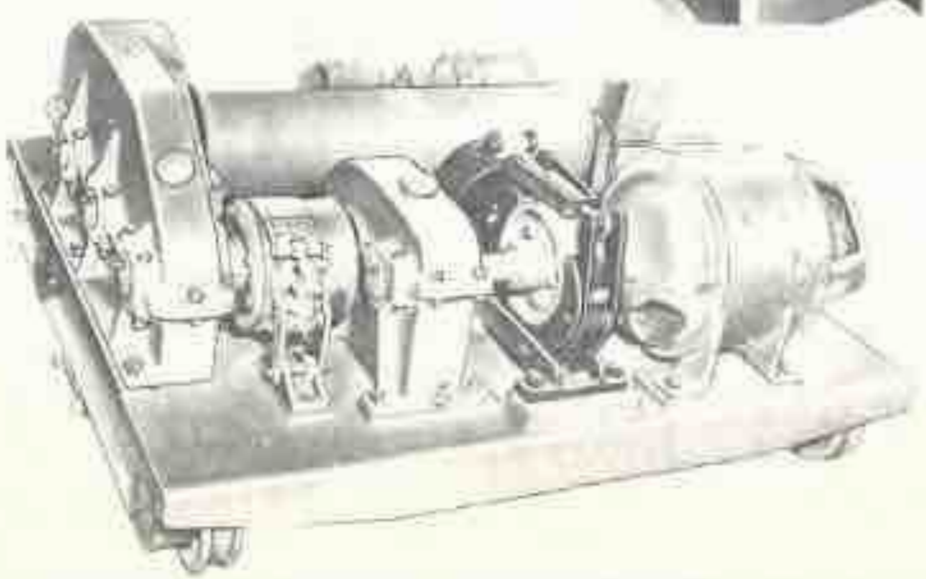
APPLYING BRAKES



The illustration at the left shows a typical application of a rigid shoe type hydraulic brake to the bridge drive center assembly of the "Shaw-Box" Types "S" and "SB" cranes. In this set-up, the brake wheel is utilized as one-half of the coupling between the motor and driving pinion. With this arrangement, motor may be removed without dismantling the brake.

The illustration at the right shows the typical application of a "Shaw-Box" floating shoe type hydraulic bridge brake to the bridge drive machinery of a large capacity direct drive crane. In this arrangement, all of the gearing for the bridge drive is contained in the housing mounted at the center of the bridge, and the brake wheel is employed as one-half of the coupling between the motor and bridge drive machinery so that motor may be removed without dismantling the brake.





The illustration at the left shows the application of a "Shaw-Box" direct current floating shoe type magnetic brake and a Type "S" mechanical load brake on a "Shaw-Box" Type "SB" crane trolley. Notice that the Mechanical Load Brake is interposed between the first and second gear reduction of the hoist gear train.

ELECTRICAL EQUIPMENT FOR CRANES

ELECTRICAL equipment for cranes is available from several sources of supply. This equipment is, however, so vital to the successful operation of a crane that it is preferable to accept the crane builder's recommendations rather than specifying the make, type, and rating of the motors and other electrical equipment to be used when issuing a specification. It should be recognized that it is the crane builder's responsibility to build the complete crane. The electrical apparatus offered may be equipment of standard make or of his own manufacture. Some builders have designed and either have built or manufacture the motors, controllers, current collectors, limit switches and the other electrical accessories and devices required on their cranes. Incorporated in the design of this equipment are those features to be found only in a product when it is designed for a single purpose. Many of the special accessories and electrical devices developed for "Shaw-Box" cranes are illustrated and described in this section.

Two kinds of electrical energy are employed for crane and hoist operation, direct current and alternating current in various voltages and frequencies. Practical definitions of each kind of current are:

DIRECT CURRENT A direct current is one that flows continuously in the same direction.

Direct currents employed for crane and hoist operation are those of 110 volts, 220 volts, and 550 volts. The most commonly used is 220 volts.

Direct current that fluctuates from 450 to 750 volts is quite common in electric railway service, and the cranes for use in their car and repair shops are equipped with special electrical apparatus suitable for operation under this condition.

ALTERNATING CURRENT Alternating current is one that flows first in one direction and then in the opposite direction at regular periodic frequencies or pulsations.

The characteristics and frequencies of alternating currents suitable for crane and hoist operation are:

Volts—110, 208, 220, 380, 440, 550
Phases—Single, Two, Three
Cycles—25, 40, 50, 60

The alternating current most frequently used for crane service is three phase, 60 cycles, at 220 and 440 volts. Single phase alternating current is only used to operate small hoists, and very seldom with motors of over two horsepower.

Alternating current is almost universally used in industrial service because of the lower cost to transmit and distribute it, and the lower maintenance cost of this equipment.

Direct current installations now are usually confined to those plants who generate their own current. Satisfactory crane performance is obtained with either current.

CURRENT REQUIREMENTS FOR CRANES

When making a new crane installation, or installing additional cranes on existing runways, it is necessary to determine, particularly in the case of new installations, the power requirements, and, in those cases where additional cranes are being installed, whether the present power supply and runway conductors are adequate. The power requirements expressed in terms of either "horsepower" or "kilowatts" may be determined from the power formulae below and ampere ratings of motors given on page 115. It is customary to consider the hoist and bridge travel motors only, disregarding the trolley motors.

POWER FORMULAE

Direct Current

W = VA

Alternating Current

Single Phase W = VAPf
Two Phase W = 2VAPf
Three Phase W = 1.73 VAPf

Values

W = Power in Watts
V = Volts
A = Current in Amperes
*Pf = Power Factor

*Power Factor usually .80 at Full Load
One Kilowatt = 1000 Watts = 1.34 Horsepower
One Horsepower = 746 Watts = .746 Kilowatts

DIRECT CURRENT MOTORS

SERIES WOUND The series wound motor is the one used almost universally on direct current cranes. The principal operating characteristics are:

A. That its speed will increase without limit as the load on it is decreased.

B. That its speed can be regulated very closely with a controller and resistance.

The series wound motor will assume overloads far beyond its full capacity until the windings burn out. Thus, there is no limiting factor to the loads that a crane equipped with this type of motor may be subjected to. In a series wound motor, there is a stationary winding known as the "field" and a rotating winding known as the "armature." At the one end of the armature is a commutator made up of insulated copper segments that take current from carbon brushes. The same current passes through the field and armature coils of series wound motors.

COMPOUND WOUND Compound wound motors are frequently used on cranes and hoists, but usually only when it is desired to limit the no-loads speeds. Its characteristics and construction are similar to that of series wound motor, except that its speed without load does not accelerate more than 150% of the full load speed due to the compound winding on the field.

AMPERE RATINGS OF MOTORS

SERIES WOUND DIRECT CURRENT

H. P.	AMPERES		
	115 Volts	230 Volts	550 Volts
2	16.1	8.0	3.4
3	24.0	12.0	5.0
4	32	16	6.6
5	40	20	8.2
7½	58	29	12.0
10	75	38	16.0
12½	94	47	19.5
15	112	56	23
20	148	74	30
25	185	92	38
30	220	110	45
35	257	128	53
40	294	146	61
45	330	163	68
50	364	180	75
60	436	215	90
75	540	268	111
90	648	322	132
100	720	357	146
125	890	443	184
150	1060	528	220
175	1240	617	257
200	1415	705	295

WOUND ROTOR ALTERNATING CURRENT—3 PHASE

H. P.	Synchronous Speed (R.P.M.)	AMPERES			
		110 Volts	220 Volts	440 Volts	550 Volts
2	1200	17.4	8.7	4.3	3.5
	900	18.0	9.0	4.5	3.6
3	1200	21.8	10.9	5.4	4.3
	900	24.8	12.4	6.2	5.0
5	1200	32.2	16.1	8.0	6.4
	900	38.0	19.0	9.5	7.6
7½	1200	47.8	23.9	11.9	9.5
	900	57.2	28.6	14.3	11.5
10	1200	58.8	29.4	14.7	11.8
	900	80.0	40.0	20.0	16.0
15	1200	90	45	22.5	18
	900	120	60	30.0	24
20	1200	116	58	29	23.2
	900	128	64	32	25.6
	720	160	80	40	32.0
25	1200	144	72	36	28.8
	900	160	80	40	32.0
	720	210	105	52.5	42.0
30	1200	170	85	42.5	34.0
	900	190	95	47.5	38.0
	720	240	120	60.0	48.0

H. P.	Synchronous Speed (R.P.M.)	AMPERES			
		110 Volts	220 Volts	440 Volts	550 Volts
40	1200	212	106	53	42.4
	900	240	120	60	48.0
	720	250	125	62.5	50
	600	320	160	80	64
50	1200	266	133	66.5	53.3
	900	292	146	73	58.5
	720	300	150	75	60.0
	600	320	160	80	64.0
60	1200	300	150	75	60.0
	900	352	176	88	70.5
	720	340	170	85	68.0
	600	388	192	96	76.8
75	900	432	216	108	86.5
	720	408	204	102	81.5
	600	460	230	115	92.0
100	900	460	260	130	104
	720	460	260	130	104
	600	620	310	155	124
125	720	640	320	160	128.0
	600	710	355	178	142.5
150	600	790	395	198	158.5
200	600	1000	500	250	200

CRANE CONTROL

It is essential in crane operation that the various motions of the crane be accurately controlled. The kind of control and the types of controllers to be used are dependent upon the service that the crane must perform and under the conditions which it must operate. There are a number of different kinds of controls and types of controllers for use in obtaining the control and speed regulation on each of the motions of the crane. The various kinds of control, types of controllers and brief practical descriptions of them follow.

KINDS OF CONTROL

MANUAL

As the term implies, manual control is when the controllers are operated by hand, either by levers or ropes, and applies to either drum or face plate type controllers. This kind of control is in common use on industrial cranes, except those having very large motors. With manual control, the full motor current is handled through the contacts and fingers of the controller. Acceleration, deceleration, and speed changes are controlled by the operator.

PUSH BUTTON

Either single speed or variable speed consists of a set of push buttons by which the operator controls each motion of the crane. With this control stops, starts, and directional changes are accomplished by reversing magnetic contactors energized by pressing on a push button operating a pilot circuit. This control is available with single speed reversing control, single speed control with automatic acceleration, and variable speed control. In the latter case, speed changes are dependent upon the distance the push button is depressed. In all cases, push button returns to "Off" position when released. It is essential that push buttons be mechanically interlocked so that, for example, hoist and lowering buttons could not be operated together.

SEMI-MAGNETIC

Semi-magnetic control consists of a combination of a manually operated controller which may be either face plate or drum type, and a magnetic contactor control working together. The circuit is opened and closed by the magnetic contactor on the first controller point in either direction. Acceleration, deceleration, and speed changes are made by the operator by and through the controller. This style of control is frequently used on cranes where the duty is more severe than average but not severe enough to warrant the expense of full magnetic control. It is also employed when heavy currents must be handled through the controllers.

FULL MAGNETIC

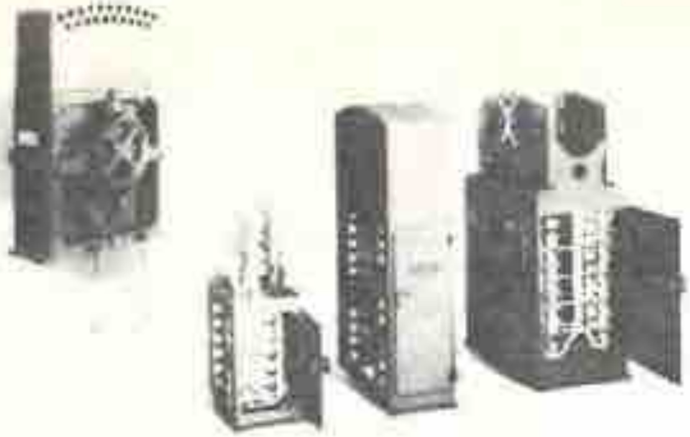
With full magnetic control acceleration and deceleration is performed automatically when the operator moves a master switch from neutral to either the forward or reverse position. Speed control is accomplished by a combination of magnetically operated contactors and time relays which are brought into action when the manually operated master switch energizes the contacts.

The operator controls starting, stopping and reversing, but he has no control over the rate of acceleration and deceleration, this being entirely automatic. Magnetic control is generally used on cranes for continuous duty, those having large motors, bucket cranes, and on steel mill cranes. Very seldom, because of the high initial cost, is it employed on cranes for ordinary industrial service.

SINGLE SPEED CONTROL

Single speed control, as the name implies, provides one speed in each direction, and is employed only when speed regulation is unnecessary. The controller is basically a reversing switch, either manually or magnetically operated.

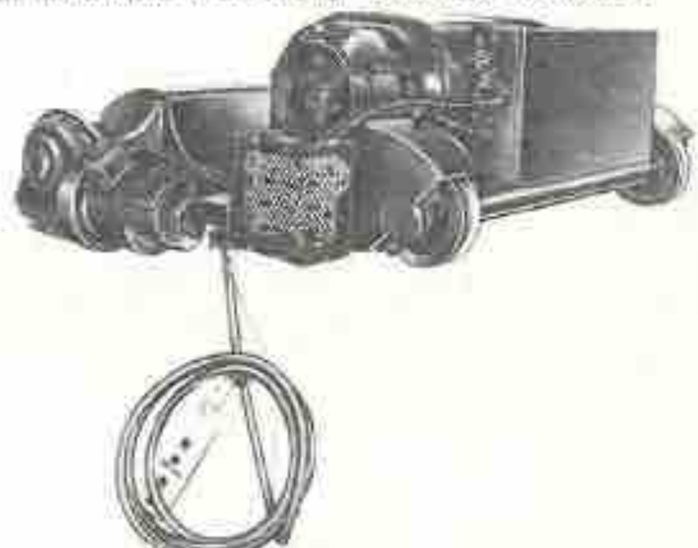
FACE-PLATE



The face-plate controller is a complete, self-contained control unit. The resistors are assembled into the controller frame, hence, this type requires the minimum of space for installation. Because it is a self-contained unit, the minimum of wiring is required to install it. All segments, brushes, and resistor units are extremely accessible. The electrical circuits are made through flat removable copper contact plates mounted on a vertical plate panel, and carbon brushes and holders are mounted on the movable lever arm. Operation may be by a vertical handle or rope wheel. This type of controller may be mounted in the back of the cage and the operating levers in the front to give maximum visibility. The illustrations at the left are "Shaw-Box" controllers.

PUSH BUTTON

Push button control is only employed on floor-operated cranes and hoists and is the most convenient form of operating floor controlled units. The magnetic contactors and resistors are mounted on the crane and the push buttons which control only a pilot circuit are suspended from an insulated cable and hang to within easy reach of the floor.



Above is illustrated typical push button control applied to a "Shaw-Box" Type "DM" crane trolley. Notice the contactors, resistance bank, and push button station suspended from the insulated cable.

SEMI-MAGNETIC CONTROL

The physical operation of semi-magnetic control is identically the same as if the operator were handling either the drum type controller illustrated on preceding page or face-plate control illustrated above, except on the first point of either of the above controllers in each direction a magnetic contactor opens and closes the circuit and speed changes are effected as the controller handle is advanced.

FULL MAGNETIC

At the right is illustrated a typical control panel for the control of a steel mill crane. Notice the banks of contactors and resistors required. In operation, the operator controls starting, stopping, and reversing by a master switch for each motor. Acceleration and deceleration are entirely automatic, with proper time intervals accomplished by relays set up for each speed change.

CRANE LIMIT SWITCHES

The upward travel of the hoist hooks is automatically stopped when they reach the highest safe position. Limit switches are employed for this purpose. Except for unusual conditions, they are not employed on any other motion of the crane.

Basically, limit switches are of two types; one, the screw type limit switch, the other the block operated type. In principle, they are both of the closed circuit type. When the load hook reaches its highest safe position, or some predetermined height, the electrical circuit of the hoist motor is opened by the limit switch, and the magnetic brake is automatically applied. On direct current cranes having fast hoisting speeds, a dynamic braking circuit is frequently established by the limit switch to limit hook drift after the electrical circuit has been broken.

SCREW TYPE

The illustration at the right shows a typical application and the construction of a "Shaw-Box" screw-type limit switch.

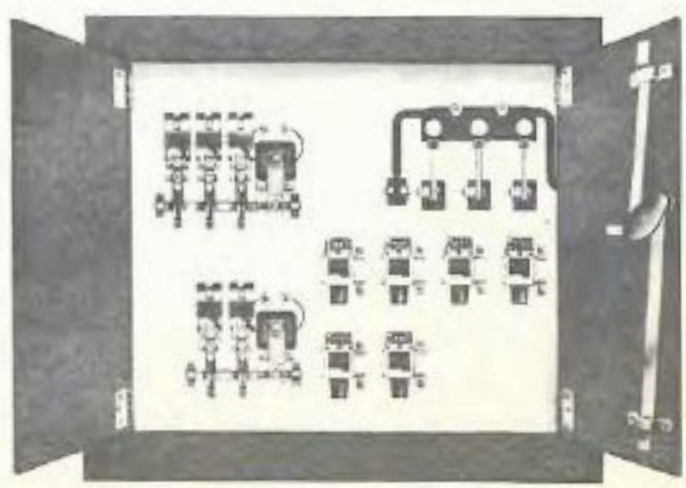
Consisting of a worm-gear set driven by a stud in the end of the drum shaft, these switches may be easily set to open the circuit at any predetermined point of lift. Because the circuit is opened by one positive mechanical drive, this type is dependable. After the hook has reached the highest position and has been stopped, it may be lowered by simply moving the controller handle in the lowering direction and the hook descends and the limit switch automatically resets.

BLOCK OPERATED TYPE

In operation, this switch functions in the same manner as the screw type switch except that the electrical circuit is opened by the load block coming in contact with and raising either a weight or paddle, the weight of which holds the switch closed against the action of a spring or weight in the limit switch. After the switch has been opened by the load hook, the hook may be lowered by moving the controller to the lowering position and the hook descends and the switch automatically resets. Adjustment for stopping the hook at some predetermined point, except the highest safe position, can be accomplished by lengthening the rope from which the weight that holds the switch closed is suspended.

CRANE SWITCHBOARDS

The crane switchboard is the distribution point from which the power is brought to the motors and all electrical accessories of the crane. After being picked up from the power supply (runway conductors) current is received at a main-line switch and individual circuits are set up for each motor. Mounted on the switchboard are protective devices against overloading for each motor circuit, a magnetic contactor to be opened by the limit switch, and the mainline switch. Switchboards should be mounted in a steel cabinet with hinged doors. The handle to open and close the main-line switch should be on the outside of the cabinet, and provision made so that the switch may be locked open when anyone is on the crane for inspection or maintenance purposes.



SUPPLYING CURRENT

BECAUSE the bridge of the crane travels along its runway and the trolley travels on the bridge, it is impossible to supply current to the motors on each and effect their control by permanent continuous wiring. Hence, bare conductors, in combination with current collectors carried on insulated poles, are used to supply current where needed. In practice, one bare conductor for each wire in the power supply is required along the runway, and one bare current conductor across the bridge is required for each wire necessary in the electrical circuit for each motor and limit switch. Their function is of such importance, because the operation of the crane depends upon them, that current collectors and current conductors should receive the same consideration in design and application as any other part of the crane mechanism.

CURRENT COLLECTORS

At the right are illustrated the different types of current collectors employed in crane practice for taking current from the main conductors and conductors across the crane bridge.

1. Slide type collectors to take current from bridge cross wires.
2. Single-wheel collector for light capacity or intermittent cranes to take current from runway wires.
3. Tandem-wheel collector used on industrial cranes to take current from runway wires.
4. Flat-shoe collector used on steel mill cranes when steel angles are used as conductors.
5. Shoe-type collector for taking current from under side of angle conductors for outdoor service.
6. Shoe-type collector used on steel mill cranes for taking current from inverted angle conductors.


1.

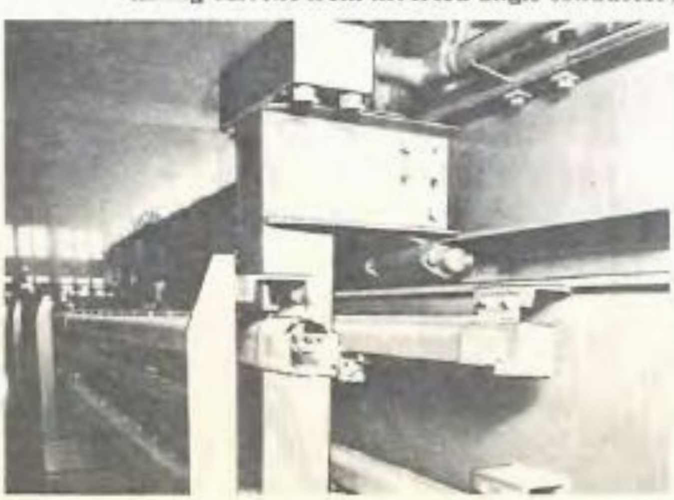

2.


3.


4.


5.


6.

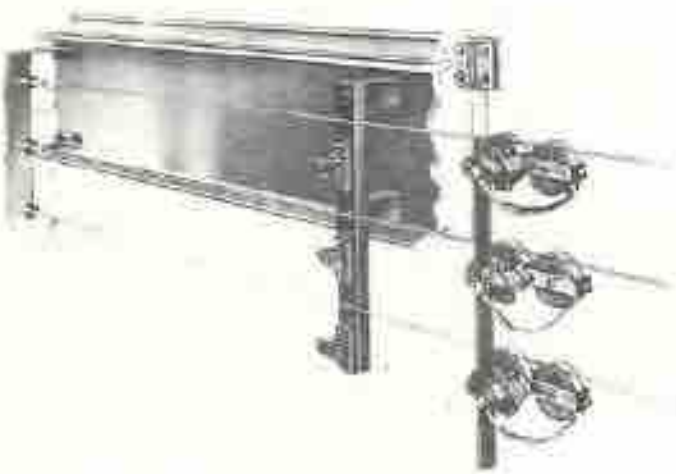


ENCLOSED CURRENT COLLECTORS AND CONDUCTORS

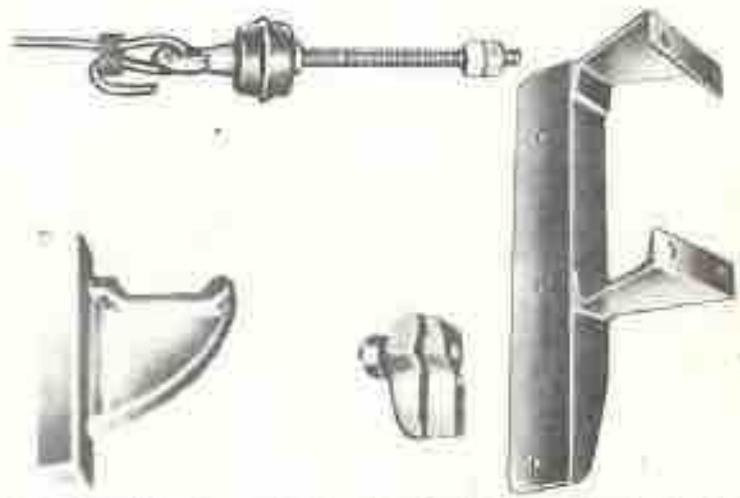
Under some conditions it is impractical, either from an operating standpoint or local regulations, to have exposed wiring on cranes. For those conditions, there have been developed several types of enclosed conductors and collectors. A typical application of this system is illustrated at the left. The conductors are protected by ducts and current collectors are in the form of trolleys operating within the duct. This conductor system is very expensive, both as to the cost of the units that make up the system and their installation, and is only used where this system is a necessity.

CURRENT CONDUCTORS

THE bare current conductors, for supplying current to cranes, are usually supported along one of the runway girders and infrequently from the roof trusses. They are insulated from the supporting building structure and crane by means of insulators made especially for this purpose. The conductors may be plain bare copper trolley wires, grooved or figure-8 bare copper trolley wires, or steel angles, "T" bars, or rails. For industrial cranes, bare copper wire and grooved and figure-8 wire are those generally used. The cross wires on the bridge are usually unsupported bare copper wires stretched taut across the bridge. But on long spans, insulator blocks are installed on the girders to prevent wires from coming in contact with the structure. The most popular types of runway wire supports and insulators are illustrated.

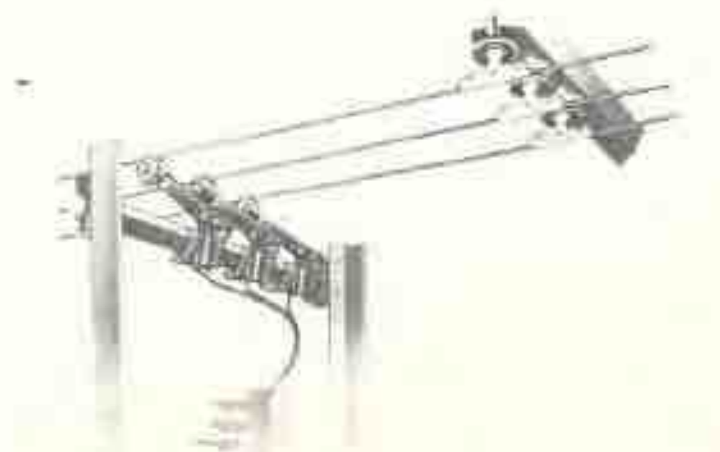


Bare copper wires stretched the length of the building and supported on insulators spaced at 20 feet intervals along runway. Bridge collectors raise wires off the insulators as crane passes. This system, known as "Shaw-Box" Type "Y" system.

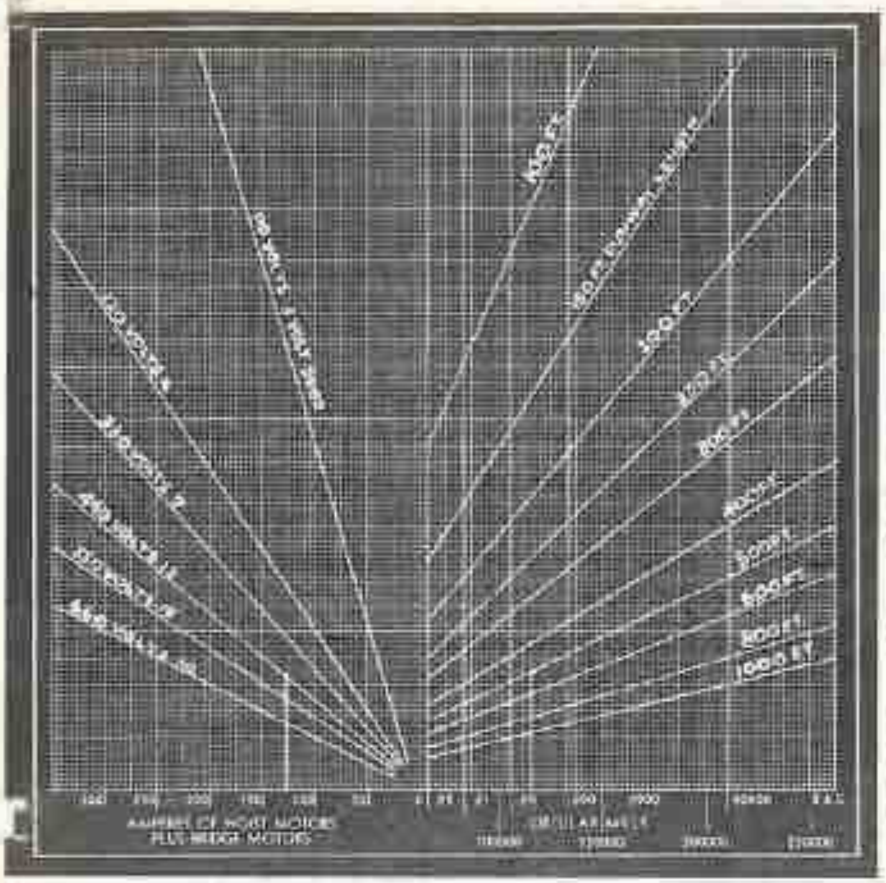


Strain insulator, intermediate insulator, feeder clip, and end anchor as used in the "Shaw-Box" Type "Y" runway system.

Runway wiring system consisting of grooved bare copper wires supported along the runway, at usually 20-foot intervals, by insulators that are free to raise and sway. This, one of the best conductor systems known, is "Shaw-Box" Type "X" runway wiring system.



Runway wires, either plain or grooved trolley wire, installed above the crane and supported either from the roof trusses or brackets attached to building columns. Notice the spring wheel type collectors used with this type wiring.



DETERMINING SIZE OF RUNWAY CONDUCTORS

Two factors govern the size of runway conductors —the length of the crane runway and the current requirements of the motors on the crane or cranes on the runway. To determine the size of runway conductors required, obtain the sum of the ampere rating of the hoist and bridge travel motors (disregarding the trolley motor), then the proper size conductors may be selected from the charts on this page. Read charts as follows: from ampere read up to the "Voltage Used," then across chart to the right to "Length of Runway," and then down to "Wire Size." Thus, for a combined current of 133 amperes at 440 volts, three phase, 60 cycle alternating current, and a crane runway 500 feet long, No. 00 conductors would be the proper size.

For practical mechanical strength and wear, No. 4 conductors are the minimum size that should be used for runways up to 60 feet long, and No. 2 conductors are the minimum size that should be used for runways over 60 feet long.

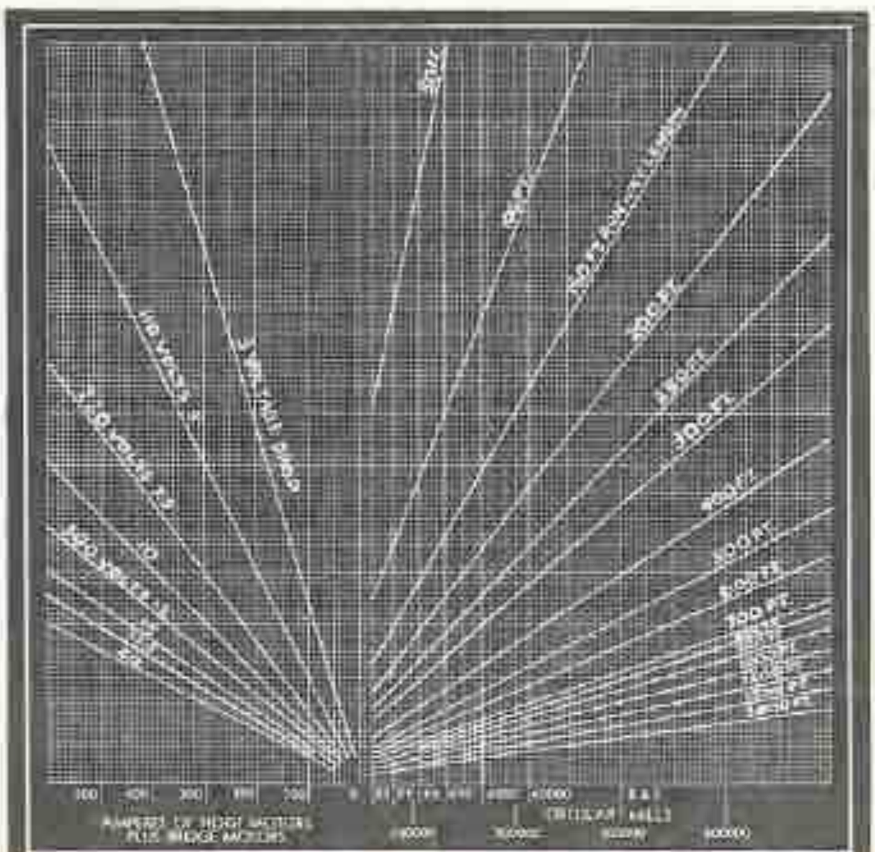
DETERMINING SIZE OF INSULATED WIRES

The ampere ratings of motors of from 2 to 200 horse-power are given on page 115. With the ampere rating of the motor known, insulated wire of the proper size may be selected from the table below. These wire sizes and ratings are suitable for motors having a "short-time rating," as defined by the standardization rules of AIEE. Wire sizes should be for 30°C temperature rise after thirty minutes. However, in no case should the wire be smaller than No. 12 B & S gauge.

Size Wire B & S Gauge	Amperes	Size Wire B & S Gauge	Amperes
12	25	0	190
10	35	00	225
8	50	000	260
6	70	0000	300
5	80	Size Wire Circular Mills	
4	55	300,000	475
3	115	400,000	580
2	130	500,000	700
1	150		

CRANE WIRING

All wiring material, including bare and insulated [illegible], conduits, fittings, and connections should be of a type approved by the National Board of Fire Underwriters for Crane Wiring. All wiring should be done in a neat and workmanlike manner, and wire should, insofar as practicable, be installed in either rigid conduits or wiring ducts.



SPRING CABLE REELS

THE function of the cable reel, regardless of its make-up, is to automatically wind and unwind a flexible insulated conductor cable that supplies current to a moving device or machine in such manner that the conductor cable is kept taut at all times. Typical examples are a lifting magnet on a crane, a monorail hoist, or a soaking pit trolley.

There are inherent advantages in the spring operated reel, not obtainable in any other type, a few of which are that the proper tension is always maintained on the cable to keep it taut; that it is entirely independent of hoisting and traveling mechanism; that the cable can pile up on the reel without affecting the speed at which the cable is wound and thus cable fastenings will not be torn loose nor the cable broken. Also, the tension of the cable pull may be adjusted to meet requirements. But, up to the advent of the patented "Shaw-Box" spring cable reel they had the disadvantage that the springs frequently fractured when the use was continuous. Spring breakage, because of the patented spring construction of the "Shaw-Box" reel, has been almost entirely eliminated. Thus, the advantages of the spring type reel may be con-

tinuously obtained. In this patented reel, the ends of the flat coil spring are anchored by compensating hinge couplings, hence there is no reverse bending on the spring and the cause for local crystallization is eliminated. A true circumferential pull is always exerted on each end of the spring. Notice the outside spring fastenings, with spring tightly wound around the hub when the cable is all unwound from the reel, and the inside spring fastenings at the hub of the reel fully uncoiled in the above illustrations.

The power supply is brought to carbon brushes making contact with collector rings at the end of the reel. The reel may be equipped with the number of collector rings and brushes required for any electrical requirement, and they may be arranged to give an automatic start, stop, and reverse of a moving mechanism.

TYPICAL APPLICATIONS

Below are illustrated typical applications of "Shaw-Box" spring drive cable reels to crane trolleys handling lifting magnets, a "crawler" crane handling a lifting magnet, and to a battery of soaking pit carriages.

OVERHEAD CRANES
FOR
STEEL MILL SERVICE

THE overhead crane has always been a necessity in the steel mill. It is of such importance that unusual precautions must be and are taken to provide against failures and tie-ups under the most unfavorable operating conditions. Out of the experience of steel mill operating men, it has become a highly specialized special purpose crane.

The Association of Iron and Steel Engineers have conducted many studies and have sponsored, in conjunction with the crane builders, much research work to arrive at specifications for steel mill cranes to insure the type of performance that is a necessity. On May 1, 1949, this Association issued specifications for electric overhead traveling cranes for steel mill service which are the standard to which steel mill cranes, in general, will be built. These specifications are known as AISE Standard No. 6, Revised May 1, 1949. They are obtainable from the Association.

The purpose of the specifications is to insure that steel mill cranes will be of strong rugged construction suitable for twenty-four hour service, seven days a week, with the minimum amount of time-out-of-service, and so readily accessible that maintenance is easy and replacements, when necessary, may be quickly made.

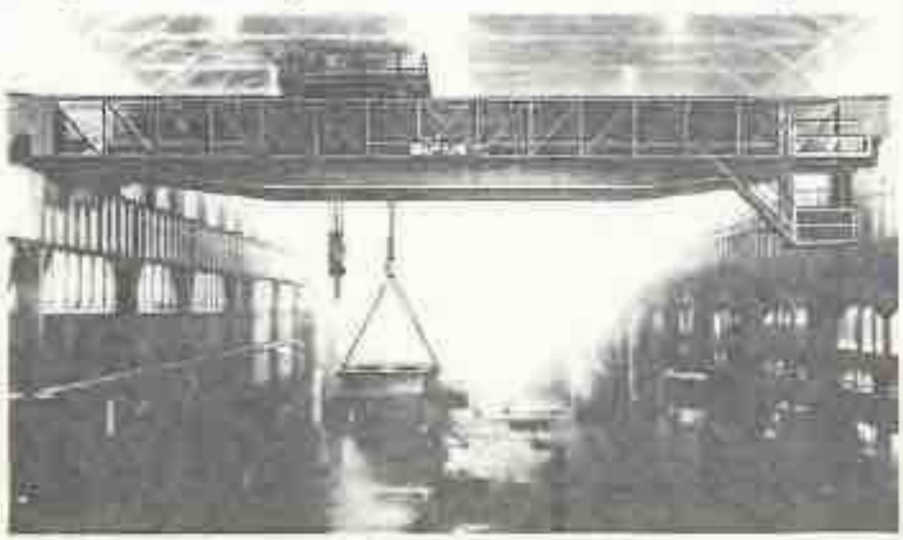
Insofar as the crane builder is concerned, steel mill cranes are "tailor-made" cranes built for a specific service to be performed in a steel mill and built to the specifications of the AISE or the specifications of the individual mill.

How well cranes built to these specifications accomplish the objective striven for depends on how much further than a literal interpretation of the specifications the crane builder is willing to go. The design, machining, and fabricating practices can either minimize or enhance the performance, operation, and maintenance costs of the crane.

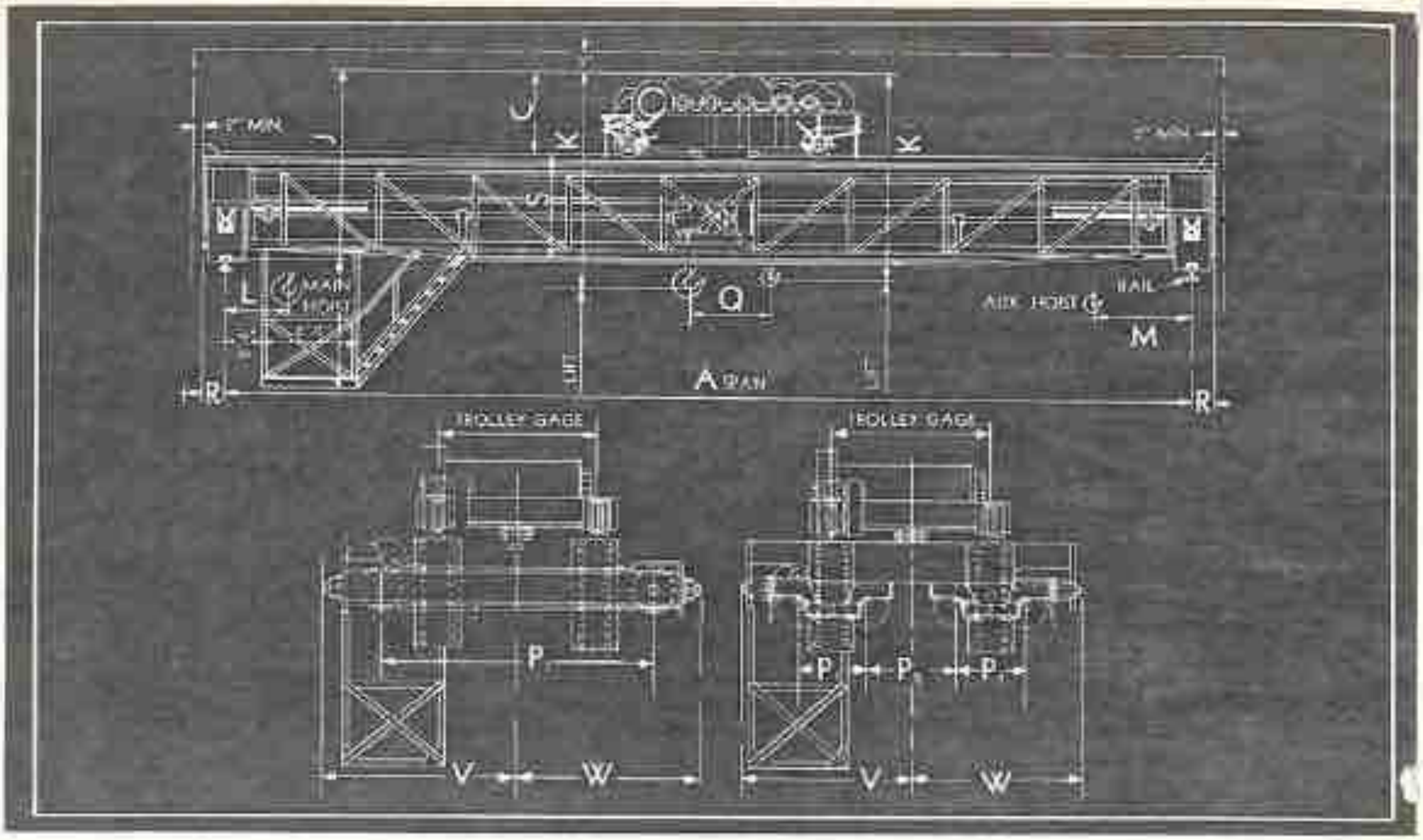
In this section are illustrations of various units that enter into the make-up of steel mill cranes as built by "Shaw-Box" as exhibits of the type of equipment they build to meet steel mill crane specifications.

DIMENSIONS

Steel mill cranes, capacity for capacity, are much larger in size than cranes built for standard industrial crane service. As a guide for use when making preliminary studies for new construction requiring steel mill cranes, dimensions of "Shaw-Box Steel Mill Cranes" from 10 to 100 tons capacity are given on the following pages. These are accurate enough to make provision for cranes within these capacities.



100 ton capacity, 58 feet 4 inch span crane with 25 ton capacity auxiliary hoist installed in a continuous strip mill.



OUTLINE DIMENSIONS

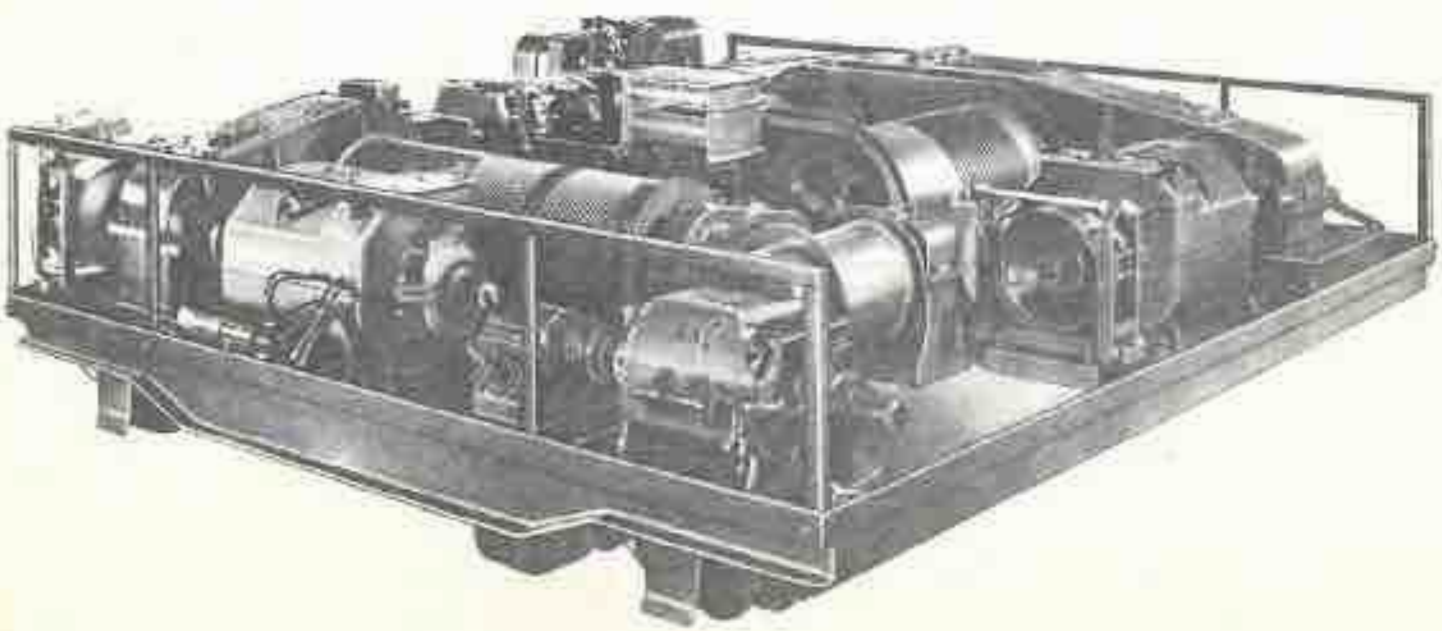
Capacity in Tons	A	Lift	J	K	K1	S	O	L	M	P	P1	R	Q	V	W	X	G	Runway Rail	Maximum Wheel Load
10	50'	40'	6' 2"	8' 2"	—	3' 5"	2' 7"	3' 0"	2' 6"	10' 5"	—	9"	—	8' 0"	7' 8"	12"	78"	60#	23,000
	60'	40'	6' 7"	8' 2"	—	3' 9"	2' 7"	3' 0"	2' 6"	10' 11"	—	9"	—	8' 9"	7' 5"	12"	78"	60#	26,000
	70'	40'	6' 2"	8' 2"	—	4' 1"	2' 7"	3' 0"	2' 6"	11' 1"	—	9"	—	8' 10"	7' 10"	12"	78"	60#	29,000
	80'	40'	6' 7"	8' 2"	—	4' 5"	2' 7"	3' 0"	2' 6"	11' 9"	—	9"	—	7' 7"	8' 2"	12"	84"	60#	32,000
	90'	40'	7' 0"	8' 2"	—	4' 9"	3' 7"	3' 0"	2' 6"	13' 0"	—	10"	—	9' 6"	8' 8"	12"	90"	70#	35,000
	100'	40'	7' 0"	8' 2"	—	5' 1"	3' 7"	3' 0"	2' 6"	14' 2"	—	10"	—	9' 8"	8' 5"	12"	90"	70#	38,000
15 3 AUX.	50'	35'	6' 6"	8' 4"	7' 2"	3' 9"	3' 10"	3' 6"	3' 7"	11' 2"	—	9"	3' 5"	9' 1"	8' 1"	18"	78"	60#	29,000
	60'	35'	7' 0"	8' 4"	7' 2"	4' 1"	3' 10"	3' 6"	3' 7"	11' 8"		9"	3' 6"	9' 2"	8' 2"	18"	78"	60#	32,000
	70'	40'	7' 0"	8' 4"	7' 2"	4' 5"	3' 10"	3' 6"	3' 7"	12' 2"		10"	3' 8"	9' 6"	8' 6"	18"	84"	70#	35,000
	80'	40'	7' 0"	8' 4"	7' 2"	4' 9"	3' 10"	3' 6"	3' 7"	12' 10"		10"	3' 8"	9' 10"	8' 10"	18"	90"	70#	38,000
	90'	40'	7' 8"	8' 4"	7' 2"	5' 1"	3' 10"	3' 6"	3' 7"	13' 0"		10"	3' 9"	10' 0"	9' 0"	18"	90"	70#	42,000
	100'	40'	7' 6"	8' 4"	7' 2"	5' 6"	3' 10"	3' 6"	3' 7"	14' 2"		10"	3' 9"	10' 4"	9' 4"	18"	96"	70#	45,000
20 5 AUX.	50'	40'	6' 11"	9' 5"	7' 6"	3' 9"	4' 1"	3' 6"	4' 0"	12' 4"	—	10"	4' 2"	10' 0"	8' 8"	12"	90"	70#	36,000
	60'	40'	7' 4"	9' 5"	7' 6"	4' 1"	4' 1"	3' 6"	4' 0"	12' 8"		10"	4' 2"	10' 4"	8' 10"	12"	90"	70#	40,000
	70'	40'	7' 4"	9' 5"	7' 6"	4' 5"	4' 1"	3' 6"	4' 0"	13' 4"		10"	4' 2"	10' 8"	9' 2"	12"	96"	70#	45,000
	80'	40'	7' 6"	9' 5"	7' 6"	4' 9"	4' 1"	3' 6"	4' 0"	14' 0"		10"	4' 2"	11' 0"	9' 6"	12"	102"	70#	50,000
	90'	40'	8' 0"	9' 5"	7' 6"	5' 6"	4' 1"	3' 6"	4' 2"	14' 6"		10"	4' 2"	11' 4"	9' 10"	12"	108"	70#	57,000
	100'	40'	8' 0"	9' 8"	7' 6"	5' 10"	4' 1"	3' 6"	4' 0"	15' 0"		11½"	4' 2"	11' 8"	10' 2"	12"	114"	80#	64,000

TROLLEYS

THERE are a great many types of crane trolleys for steel mill cranes required for the various operations in the steel mill. Those illustrated on the following pages typify the engineering interpretation of specifications to meet these requirements by "Shaw-Box". They are also representative of the most modern trends and practices followed in fabricating quality cranes ranging from a simple single hook trolley to a trolley to handle both a magnet and a grab bucket.

Because the hoisting motion and the trolley travel motion of steel mill cranes are in almost continuous operation, it is of utmost importance that two conditions be met. First, that all operating parts are very heavily proportioned to provide for a large wear factor, and also that each individual wearing part must be readily accessible for inspection and maintenance purposes.

The trolley illustrated below is a combination magnet and bucket handling crane trolley having three hoisting units; two of them to operate a two-line grab bucket, and the third to handle a lifting magnet. Notice the "Shaw-Box" spring drive cable reel mounted on the trolley to handle conductor cable for the lifting magnet.

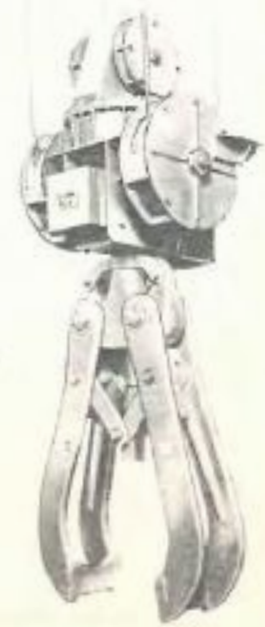


TROLLEY DETAILS

At the left are top and bottom views of a typical trolley frame for a steel mill crane prior to the mounting of the machinery units. Notice the machining pads for the machinery units to eliminate the necessity of using shims to obtain perfect alignment. Notice also how rigidly the frame is braced in all directions. Frame is built up entirely of structural steel members welded into a rigid one-piece unit.

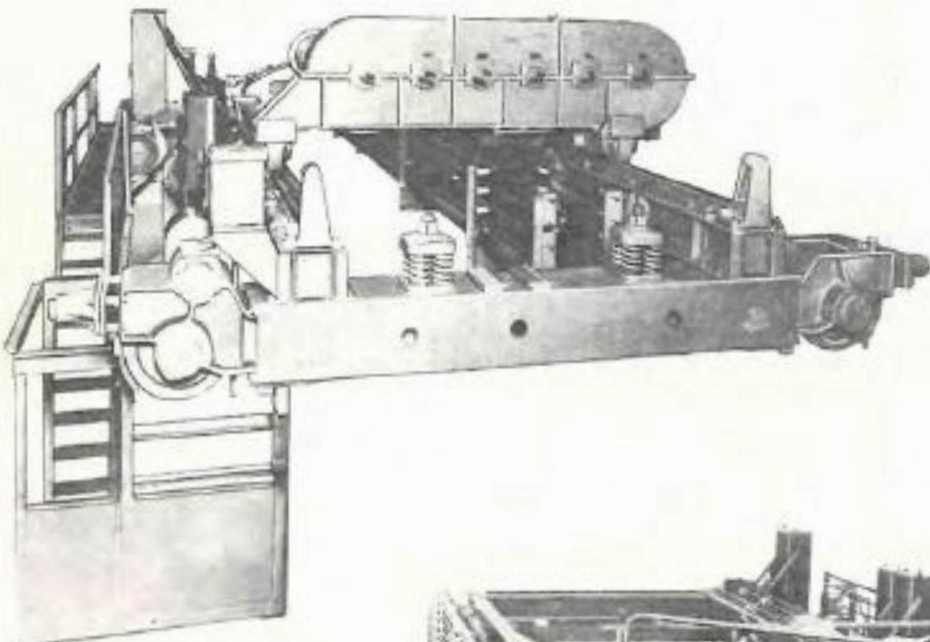
LIFTING TACKLE

At right are illustrations of typical safety lower blocks and hooks (single hook and sister hook types) as well as a motor operated tong used for several conditions that prevail in steel mills.

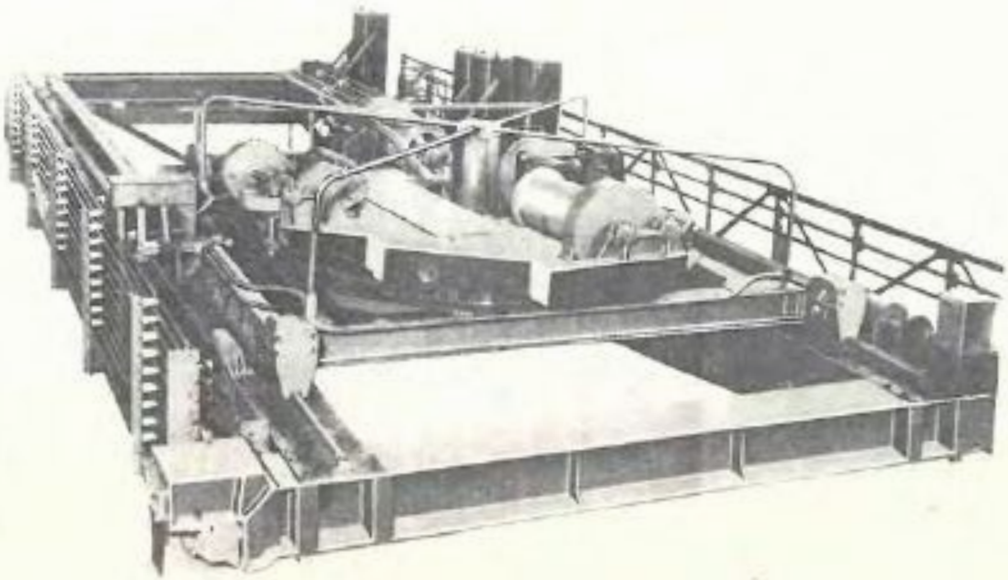


SPECIAL SERVICE EQUIPMENT

TO MEET all of the crane requirements of steel mills, there are cranes designed specifically to perform a special service. Each of the individual crane builders have specialized on certain types — "Shaw-Box," for example, has specialized in the development and building of plate handling cranes, soaking pit carriages, and cranes with multiple lifts for certain operations in tube mills. By focusing their attention particularly on these specialties, they have become known as specialists for the supplying of this type of equipment.

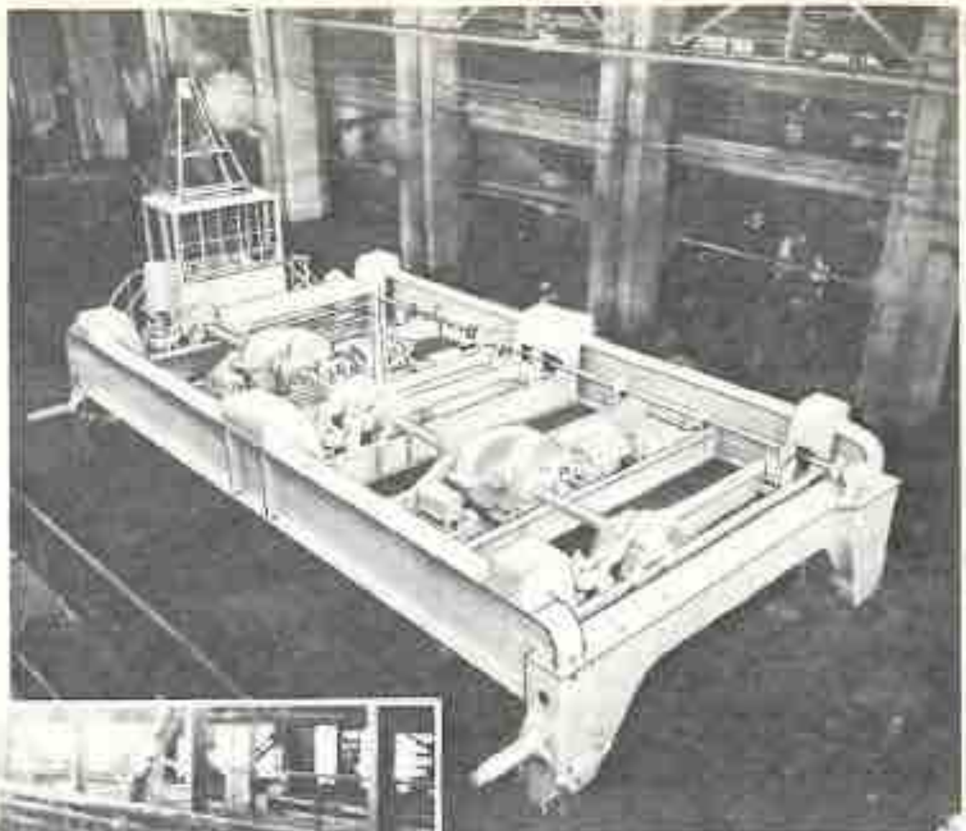


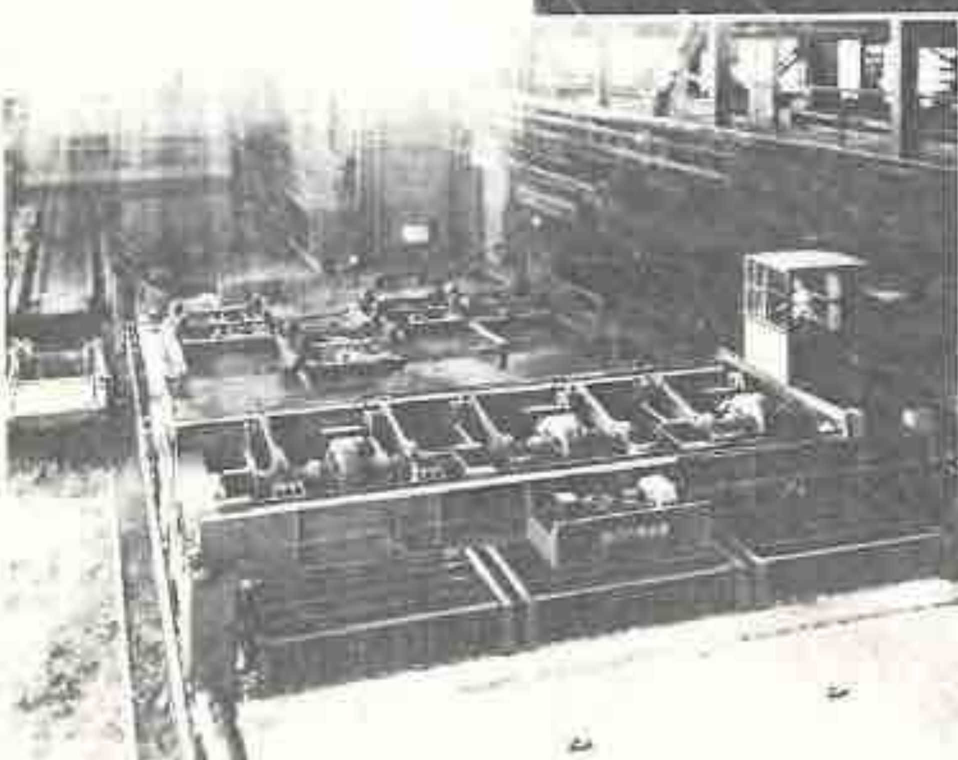
At the left is illustrated a special four-point lift (four hooks) steel mill crane with all hooks operating simultaneously. The crane illustrated is equipped with "Shaw-Box" patented spring end trucks to relieve the building of the impacts set up by the crane. This end truck is described in detail on page 79.



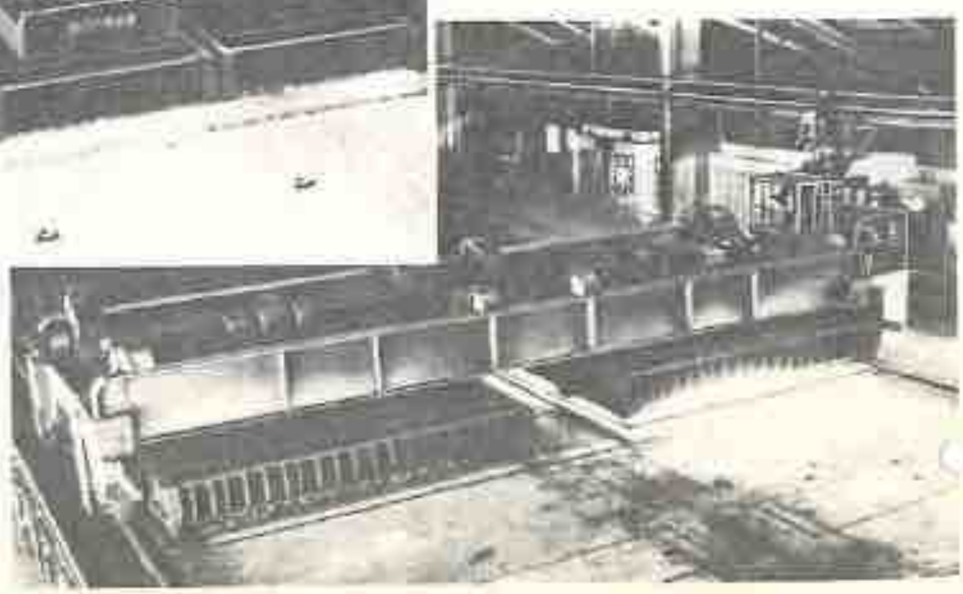
At the right is illustrated a two-hook special crane of 15-ton capacity (independent hoisting units) mounted on a rotating trolley. The trolley rotates 360 degrees.

At the right is a shop view of the latest design "Shaw-Box" soaking pit carriage. Notice the rugged construction, clean cut design, and the protection afforded the mechanism from heat.





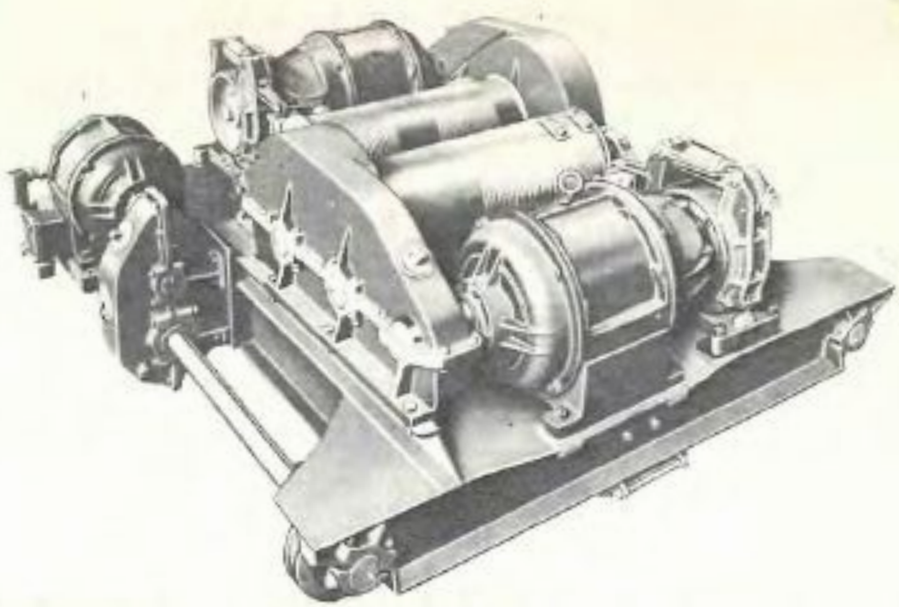
Typical installation of a soaking pit carriage serving three rows of pits. Notice the eccentrics employed as the lifting medium.



A typical installation of a soaking pit carriage serving two rows of pits. Notice pit cover at the right has been lifted.

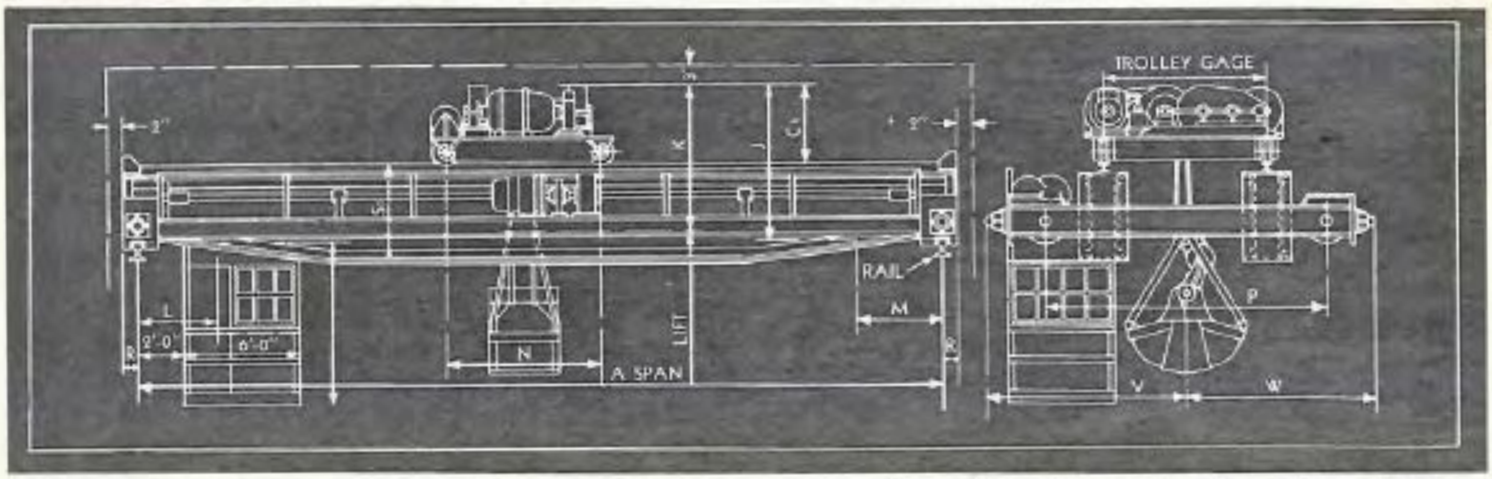
and quickly made to keep the time-out-of-service to a minimum.

In general, a grab bucket crane con-consists of the usual heavy duty industrial crane bridge with a hoisting trolley having two hoisting mechanisms, one to operate the closing line of the grab bucket and the other to operate the holding lines. At the right is illustrated a trolley for a grab bucket crane as built by "Shaw-Box." In make-up, the hoisting mechanisms are similar to those employed in standard heavy duty industrial cranes. Proper application of motors for this type of crane is given in Section V.



OUTLINE DIMENSIONS

Outline dimensions of "Shaw-Box" bucket cranes are given below. Capacity rating is on the basis of the weight of the bucket plus the weight of the material handled by the bucket.



Capacity in Tons	A	J	K	S_1	C_1	N	L	M	P	R	V	W	Lift	G	Rail	Maximum Wheel Load
2	50'	4' 10"	2' 6"	2' 9"	3' 2"	5' 8"	4' 0"	3' 9"	10' 1"	7½"	10' 8"	6' 6"	60'	6' 6"	50#	13,000
	60'	4' 10"	2' 6"	3' 5"	3' 2"	5' 8"	4' 0"	3' 9"	10' 8"	7½"	10' 8"	6' 6"	60'	6' 6"	50#	14,000
	80'	5' 0"	2' 6"	4' 1"	3' 2"	5' 8"	4' 0"	3' 9"	11' 10"	8½"	10' 8"	7' 1"	60'	6' 6"	50#	19,000
	100'	5' 2"	2' 6"	4' 9"	3' 2"	5' 8"	4' 0"	3' 9"	14' 2"	8½"	10' 8"	8' 1"	60'	6' 6"	50#	20,000
3½	50'	5' 4"	3' 0"	2' 9"	3' 4"	6' 8¼"	4' 3"	4' 0"	10' 7"	7½"	11' 0"	6' 9"	75'	7' 0"	50#	15,000
	60'	5' 4"	3' 0"	3' 5"	3' 4"	6' 8¼"	4' 3"	4' 0"	11' 2"	7½"	11' 0"	6' 9"	75'	7' 0"	50#	16,800
	80'	5' 4"	3' 0"	4' 1"	3' 4"	6' 8¼"	4' 3"	4' 0"	12' 4"	8½"	11' 0"	7' 4"	75'	7' 0"	50#	22,000
	100'	5' 4"	3' 0"	4' 9"	3' 4"	6' 8¼"	4' 3"	4' 0"	14' 2"	8½"	11' 0"	8' 1"	75'	7' 0"	50#	23,000
5	50'	5' 4"	3' 6"	3' 5"	3' 4"	7' 9½"	4' 9"	4' 6"	11' 9"	7½"	11' 4"	7' 3"	90'	8' 0"	50#	21,000
	60'	5' 6"	3' 6"	3' 9"	3' 4"	7' 9½"	4' 9"	4' 6"	12' 0"	7½"	11' 4"	7' 3"	90'	8' 0"	50#	22,000
	80'	5' 8"	3' 6"	4' 5"	3' 4"	7' 9½"	4' 9"	4' 6"	12' 4"	8½"	11' 4"	7' 10"	90'	8' 0"	50#	24,000
	100'	5' 8"	3' 6"	5' 1"	3' 4"	7' 9½"	4' 9"	4' 6"	14' 2"	8½"	11' 4"	8' 4"	90'	8' 0"	50#	26,000

Dimension "V" is greater than on standard three-motor type "S" cranes in order to allow 1'0" clearance between cab and bucket.

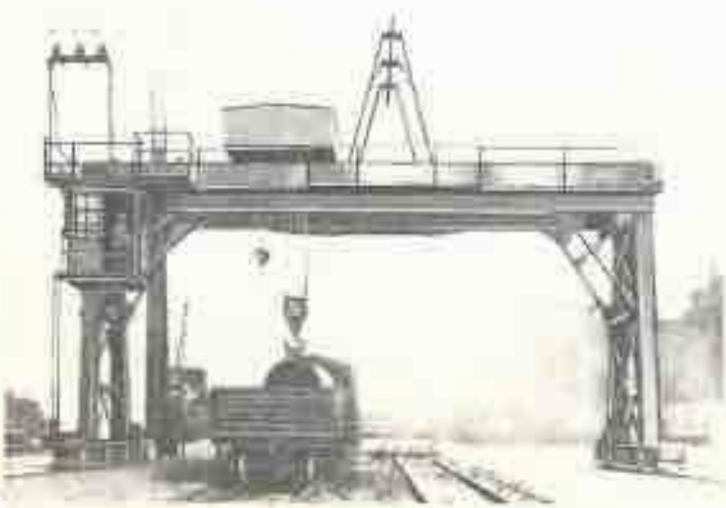
GANTRY CRANES

Gantry cranes are built in two styles, one the traveling type, the other the stationery type. The traveling type has three motions; hoist, trolley travel, and bridge travel, and is designed to serve large areas. The stationery type has only two motions; hoist and trolley travel, and is commonly only employed for intermittent service. Unlike the overhead type, both types are supported from the ground; the stationery type on a permanent foundation, the traveling type on rails installed on foundations of either railroad ties or concrete of proper proportions to resist wheel loading on the crane.

An unusual type of gantry crane. This crane is 200 feet in length and has a lift of 85 feet. It is used to unload miscellaneous material from ships, lifting it from the ship and depositing it on the platform shown on the left of the crane and then the entire load is transported along the dock by the crane.

Above illustration is of a magnet handling Gantry Crane with a cantilever at each end, performing a typical rapid handling service. This crane is used to load and unload freight cars in a large scrap yard.

Single leg coal handling gantry crane employed to unload and rehandle all the coal used by a large power plant.



A typical stationary gantry crane as used at transfer points of railroads where volume is comparatively small but material to be handled is heavy.

Traveling gantry crane as employed at transfer points of railroads w... volume of freight to be transferred is too great to be economically done by a stationary gantry crane, as illustrated at the left.

ICE PLANT CRANES

THE overhead crane is an important piece of equipment in the ice plant. It is employed to pull the ice from the freezing tanks and take it to the ice dump. The type of crane employed depends upon the number of cans that are to be pulled at a time. For small plants, where two cans are pulled at a time, the single girder push type with electric hoist equipped with can dogs is the most popular arrangement.

When four to six cans are pulled at once, the usual arrangement is a single girder electric crane, an illustration and dimensions of which are shown on page 34, with which a lifting bail is employed. The illustration at the right shows a typical installation of this type of crane pulling six cans of ice from the freezing tank.

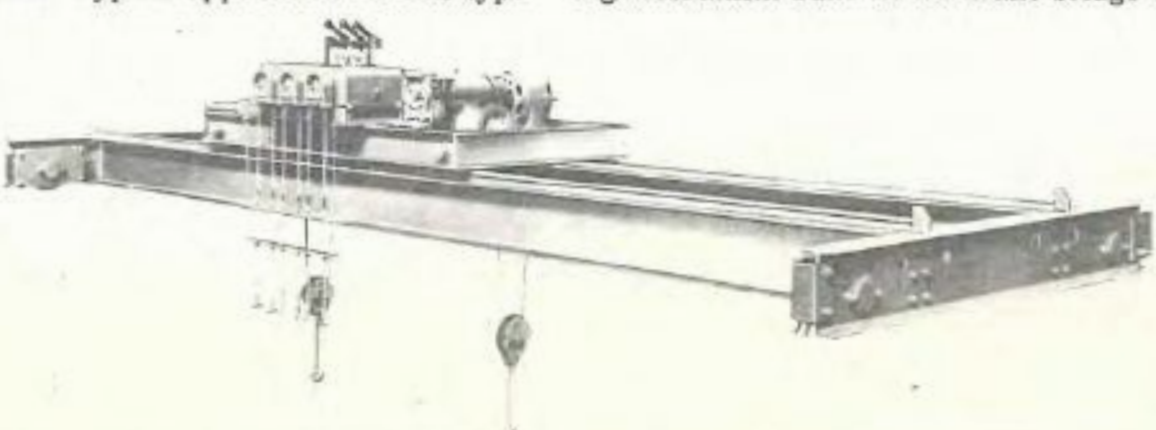
When more than six cans are to be pulled from the freezing tank at a time, then the multiple point lift crane is employed.

SINGLE POINT LIFT

Single point lift push type crane, as used in small ice plants. Bridge and trolley travel is accomplished by pushing on the load. Bridge wheels are of large dimensions to permit fast easy travel. Hoist is heavy duty electric hoist with push type trolley equipped with can dogs instead of the usual hoist hook.

MULTIPLE POINT LIFT

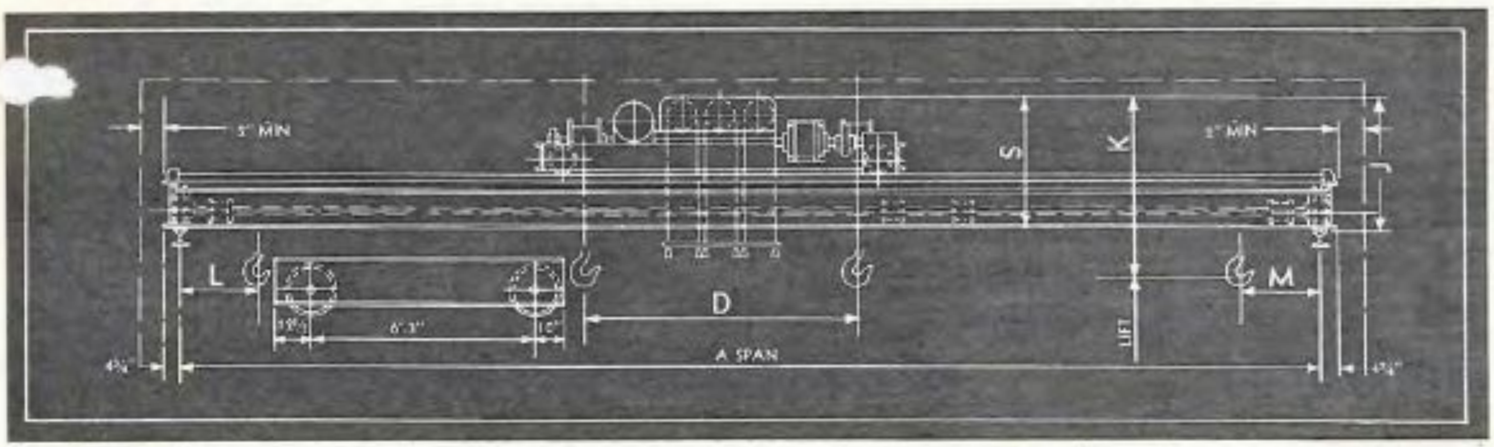
Multiple point lift ice plant cranes come in two types, one consisting of a standard crane bridge with a crane trolley with two hoisting hooks operating in unison. This type is employed to pull up to 13 cans at a time. Typical applications of this type crane are shown on the next page, and the dimensions of the sizes in which this type is available are also on the opposite page. The other type is of almost similar design, except that it has a stationary hoisting mechanism built on the crane bridge with from



three to six hooks operated simultaneously by the one hoisting mechanism and carrying the lifting bail. This type of crane is employed in large ice plants where it is desirable to pull an entire row of cans at a time.

In make-up, multiple point lift ice plant cranes are built up of standard units. The bridge is a standard overhead electric traveling crane bridge and the trolley or stationary hoisting units are built up from the units employed in the make-up of standard crane trolleys.

OUTLINE DIMENSIONS MULTIPLE LIFT CRANES



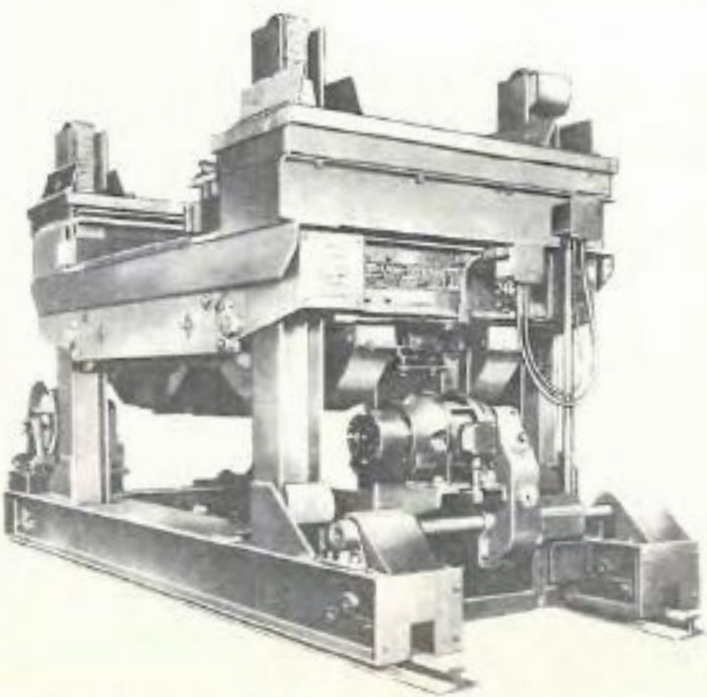
Capacity in Tons	Lift to	A Span to	C Rail to Roof	J	K	L	M	S	Rail	Maximum Wheel Load
7 300 LB. CANS / 6 400 LB. CANS	8' 0"	20'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,300
	8' 0"	25'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,450
	8' 0"	30'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,630
	8' 0"	35'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,850
	8' 0"	40'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,000
10 300 LB. CANS / 8 400 LB. CANS	8' 0"	20'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,500
	8' 0"	25'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,750
	8' 0"	30'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,100
	8' 0"	35'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,150
	8' 0"	40'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,300
	8' 0"	45'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,550
[illegible] 300 LB. CANS / 10 400 LB. CANS	8' 0"	20'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,700
	8' 0"	25'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	3,900
	8' 0"	30'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,350
	8' 0"	35'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,500
	8' 0"	40'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	4,800
	8' 0"	45'	3' 0¾"	2' 10¼"	3' 8"	1' 0"	1' 0"	2' 10"	30#	5,300

DROP PIT TABLES

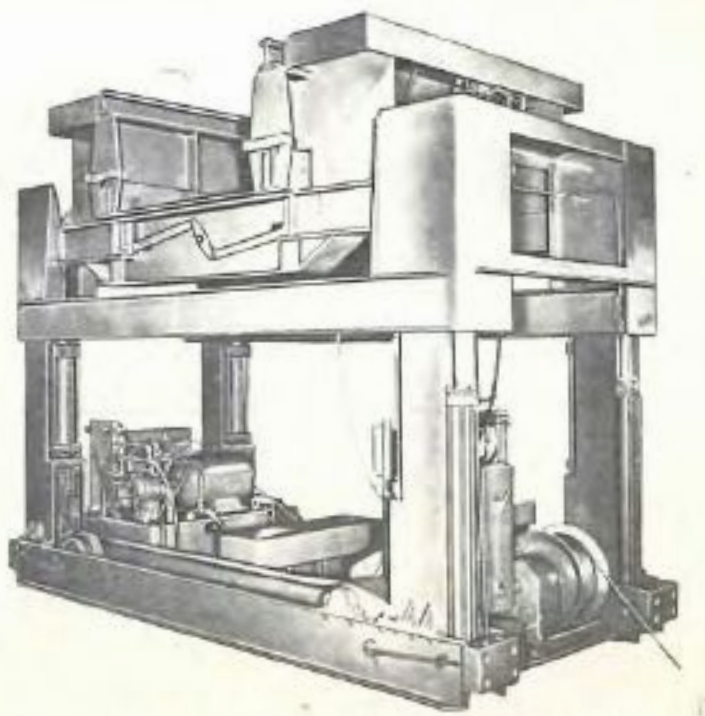
THE drop pit table is a special purpose machine exclusively used by railroads and electric railway systems. It is employed at division points, back shops, roundhouses, and coach shops to permit economical maintenance of the rolling stock at these points instead of at the main shops. It is a necessity at the main car and locomotive repair shops because it is utilized to remove and replace locomotive drive wheel sets, tender trucks, car trucks, Diesel wheel sets, trucks, and motors.

The table is installed in a pit that intersects each of the tracks that the drop pit table is to serve, because one table will serve a number of tracks. The gap in each service track is spanned by a table top on which there are matching rails. The table top is locked in position, hence the tracks, except when drop pit table is in operation, are continuous and rolling stock may pass over them without interruption.

The two types of drop tables developed by "Shaw-Box" were each a new engineering development in drop tables—their electric table in 1929 wherein lifting was accomplished by means of flat steel cables and winding drums, and their hydraulic tables developed in 1949 developed principally for



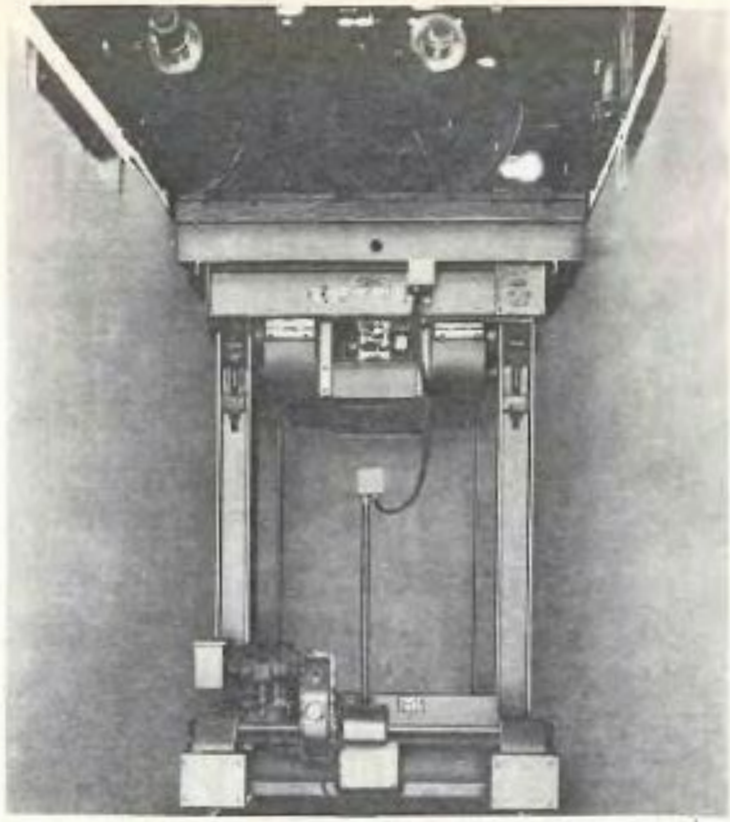
From this view of a "Shaw-Box" electric table with its top, may be appreciated the simple clean-cut design and rugged construction. Notice that the trucks are the same as that of a crane, and that the traveling gear and housing is the same unit as used in the trolley drive of a crane.



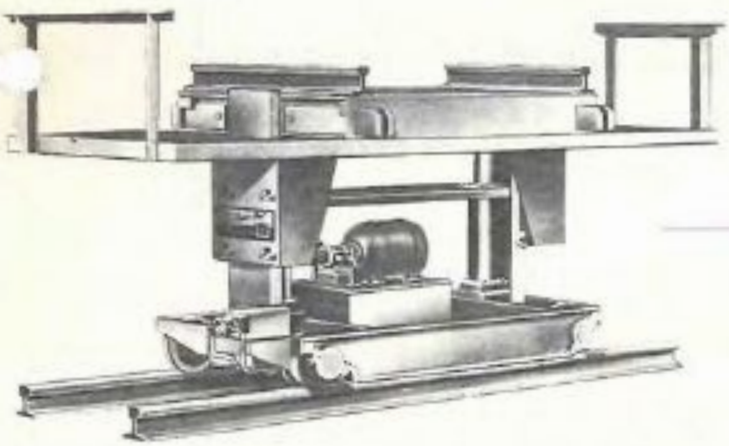
Hydraulically operated table developed particularly for Diesel shops. Operating time cycle is approximately twice as fast as the usual table because of two speeds of lift, a fast speed for quickly raising and lowering table and a slow speed for use in "working zone" on heavy loads.

Diesel shops. Both designs and many of the details of them are covered by patents and applications that are pending.

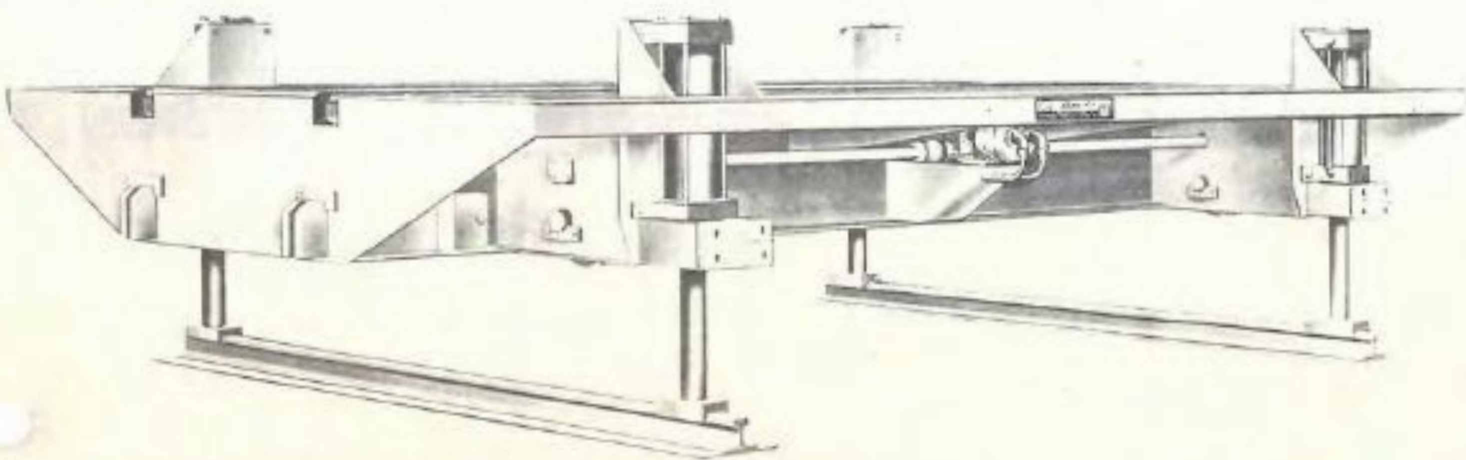
In make-up, each type consists of the table truck and the table top which is raised and lowered by motors on the electric table and by hydraulic cylinders on the hydraulic table. The table top is detachable and equipped with locking bars, and sections of rail form a continuous rail over the pit when it is locked in position. Movement of table along the pit may be accomplished by pushing on the load, by a crank handle, and on electrically operated tables by electric motor, and on hydraulic tables by hydraulic motor.



The above view shows the first operation in removing a pair of drivers from a locomotive with an electric table. After wheels are lowered, the table is traveled to the service track and the wheels rolled out and are ready to be taken to the repair shops.



Hydraulically operated table developed particularly for servicing passenger and freight cars. On this table the operators stand on a platform integral with the elevator so they are always at the same level as the axle being handled.



Hydraulically operated table developed for use in shallow pits. This is a self-contained unit. Pit required is only approximately 4' 6" deep.

CAR BODY SUPPORTS

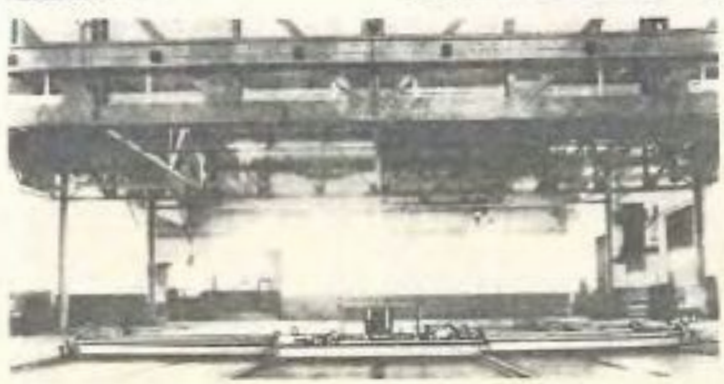
An essential piece of equipment for car repair shops are supports for car bodies. They come in a variety of styles, the most popular being the crane type and the floor mounted type as illustrated at the left.

The crane type consists of a simple electrically operated bridge on which two electrically traveled trolleys, each with a rigid arm with feet below to engage the sill of the car body. The floor mounted type consists of two girders, each supported on pedestals and carrying hand operated trolleys with seats to engage the sill of the car body. Both types are used to support car bodies after they have been raised off of the trucks until the trucks have been serviced; thus, releasing the overhead crane or drop table for other duties.

TRANSFER TABLES

Transfer tables are employed in the railway yard and shop as a medium to transfer locomotive and cars from one track to another, or from shop to yard, or vice versa. Operating on rails in the shallow pit, the rails on the top of the table match up with rails on each side of the pit so that rolling stock may roll or be pulled on the table and transferred to the desired track. Electrically operated pulling winches and guide sheaves are mounted and guide cars or locomotives on or off the table.

In construction they are similar to a crane bridge and design principles are the same as for crane bridges as outlined in Section V. However, because of the desirability of keeping the pit as shallow as possible, intermediate trucks and wheels are employed to divide the total length into short spans.



(2) Check for and remove any loose parts, such as bolts, nuts, bars, hammers, wrenches, and the like that may have been inadvertently left on top of the girders or trolley or on the top of the platform.

(3) Check for any oil spillage that may have occurred during erection and wipe oil spots dry.

(4) Thoroughly grease every bearing on the crane and check all gear housings for oil.

(5) Grease the hoisting rope.

In the original and subsequent lubrication of the crane, be sure to use the lubricants recommended by the crane builders.

WHEN YOU FIRST START THE CRANE

Before the crane is placed in service, there are three very important things that should be done. First, check the direction of rotation of each controller handle to effect movement of each of the crane's motions. Next, check the operation of the hoist motor brake, and finally set the upper limit stop so that the current is shut off when the crane hook reaches its uppermost safe limit of travel. Slight adjustment of each of the above points may be necessary so that each of these units operate as the crane builder intends that they should.

Instructions for making the adjustments that may be necessary are in the instruction manuals that usually accompany the crane.

MAINTAINING CRANES

An overhead crane represents a sizeable investment which has been made to obtain the service that an overhead crane can give. This investment can and should be protected, as by doing so the life of the crane is prolonged and the cost to maintain it kept to a minimum. By following regularly just a few simple practices, crane tie-ups and operating expenses may be kept to the very minimum.

Experience has shown that the majority of failures of any mechanical appliance are usually traceable to lack of lubrication. Hence, it is of paramount importance that the crane be regularly lubricated at all points as directed by the crane manufacturer with the lubricants recommended by the crane manufacturer.

Regular thorough inspection of all parts of the crane should be made. Any fastenings that have become loose should be tightened immediately. As parts wear, they should be replaced without delay.

Commutators and slip rings of motors should be regularly cleaned and replaced as they become worn. Controller fingers and contacts should be kept clean and they should be replaced when they become pitted or burned. Current collectors should be replaced as they wear.

The limit stop that prevents over-travel of the crane hook should be regularly checked. All brakes should be kept in adjustment. On alternating current cranes, if the brake is solenoid operated, it is essential that the proper air gap of the solenoid be maintained. Ropes should be regularly treated with rope lubricant, and if any strands are broken the rope should be replaced.

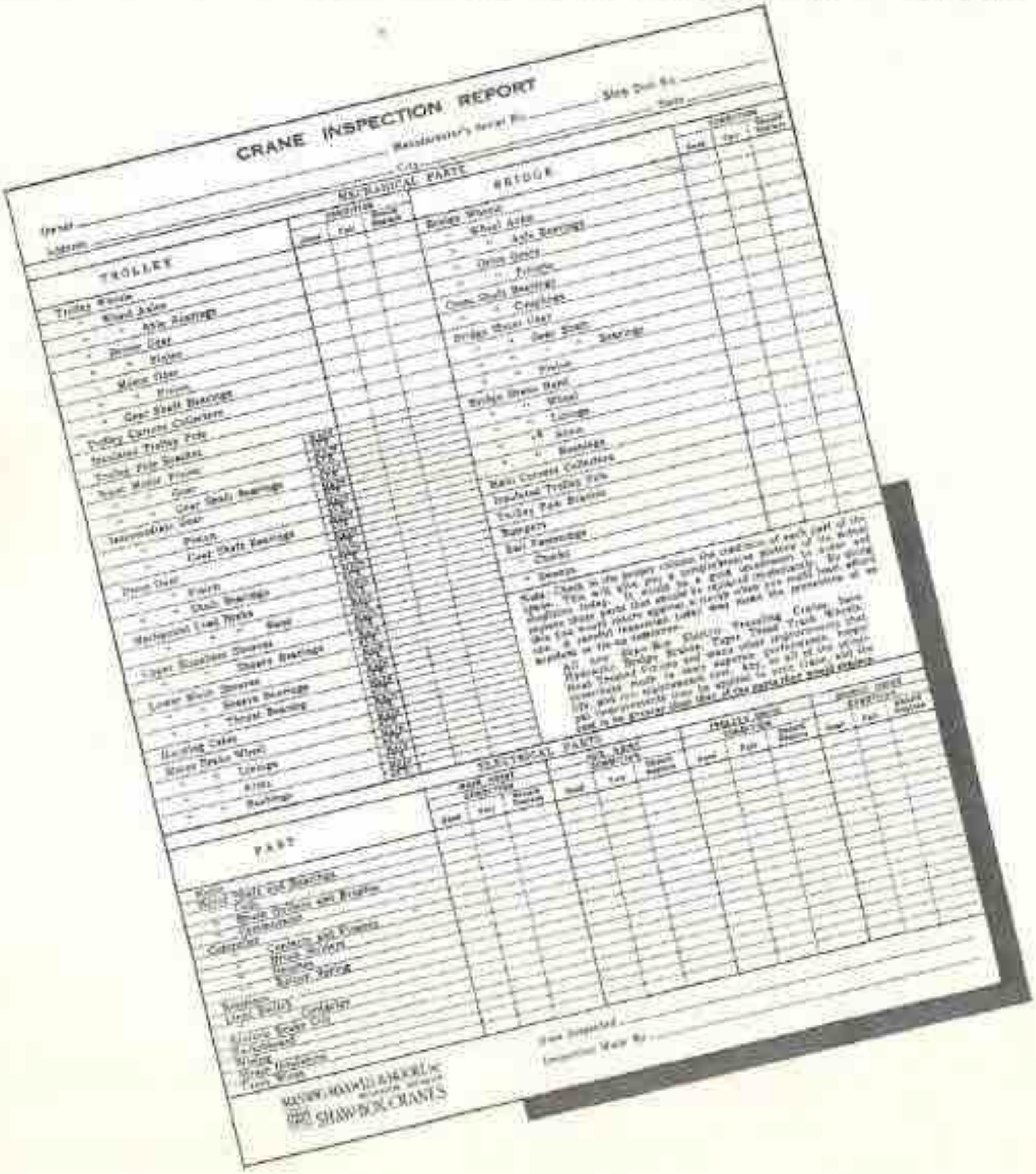
By following these few simple rules, maintenance costs will be greatly reduced and new crane performance will be continuously maintained.

INSPECTION

The majority of crane tie-ups and failures are attributable to superficial instead of thorough crane inspection. This may be avoided if it is set up with the maintenance department of the plant that the cranes are to be thoroughly inspected at regular intervals. In order to insure thorough inspections by

...e users of their cranes, the sponsors of this book have developed the Crane Inspection Report, reproduced below. This form has been very effective in insuring thorough inspections; has been adopted as a standard by many of the largest crane users.

Of equal importance to thorough inspection, is that the adjustments that the inspections show should be made are made, and the parts that the inspection shows should be replaced are replaced as quickly as possible after the inspection.



CRANE INSPECTION REPORT

MECHANICAL PARTS

TROLLEY

BRIDGE

ELECTRICAL PARTS

PART

SHAW-BOX CRANES

OPERATING ELECTRIC TRAVELING CRANES

THE CRANE operator's job is an important one in industry, because all materials and finished parts must be handled not once, but many times during the production process. And all of this handling is controlled by the crane operator. The crane operator's responsibility should be outlined to him or her because, at his fingertips, is the safety of his fellow employees and the power to prevent damage to expensive equipment. Here are suggestions that have, in the past, proved helpful to many crane operators.

LEARNING THE CONTROLS

With the main switch open (power shut off) he should operate each controller in both directions to get the feel of each control and determine that none of them bind or stick in any position. He should always check to find out which crane motion and the direction that each controller affects before operating the crane. This is done by first making sure that all controllers are in the "Off" position, then closing the main line switch so that the power is "On." Then move successively each of the control handles slowly to see what happens and immediately return the handle to the "Off" position. After this has been done, the operator will know the controller that operates each motion and the direction of movement the controller handle effects when thrown in each direction.

OPERATING THE CRANE

The measuring stick of good crane operators is the smoothness of operation of his or her crane. Jumpy and jerky operation, flying starts, quick reversals, and sudden stops, are the trade marks of the careless operator. The good operator starts all motions slowly and accelerates the speed, step by step, until the fastest speed is reached. They stop the crane slowly by returning the controller handle to the "Off" position, step by step. And they learn to judge the drift of each motion of the crane after the power has been shut off.

HOIST MOTION

After the slings have been placed around the load and the signal has been given by the floorman to start hoisting, the hoist hook should be started upward very slowly until all slack has been taken out of the slings. After the slack has been taken out, and the floorman determines that the load is in balance, then the floorman gives the signal to continue hoisting. In doing this, the load should be assumed by the crane very slowly until the load is clear of the floor. Then the hoisting speed can be increased and maintained until the load is clear of all obstructions or the floorman signals for a stop.

When lowering loads, the lowering speed should be gradually brought up to speed until the load is near the place that it is to be landed. At that point, the speed should be reduced to the slowest possible speed. Now it is very important that the operator pay particular attention to the directions of the floorman. The last few inches should be accomplished by quickly moving the controls handle on and off of the first point of the controller. This gives a slower than normal lowering speed and is termed "inching."

TROLLEY MOTION

Usually there are no brakes to control the drift of a crane trolley, therefore, this motion must be handled more delicately than any other motion of the crane. It is hardly ever necessary to bring the trolley up to full speed, because of the distance it will drift after the power is shut off. When handling loads, the trolleys should always be brought directly over the load that is to be handled. If this is not done, when the slack is taken out of the slings and hoisting is started, the trolley will be brought directly over the load by the load and as hoisting is continuing, the load will start swinging.

BRIDGE MOTION

Before a load is handled by the crane, the bridge also should be brought directly over the load, otherwise it is impossible to "spot" the trolley and hoist hook over the load. The bridge travel motion has an additional control—a brake usually operated by a foot pedal in the cage. The purpose of this brake is to permit stopping of the crane bridge exactly where desired. After the operator learns the distance that the bridge "drifts" after power is shut off, he will be able to judge distances so that the need to employ the foot brake will be greatly reduced. This is highly desirable. When it is necessary to move the bridge very slight distances, then the practice of "inching," as previously described, should be followed.

SOME THINGS CRANE OPERATORS SHOULD ALWAYS REMEMBER

The safe handling of loads is the responsibility of the floorman, and it is therefore of utmost importance that the crane operator follow the directions of *one man* in the floor gang. Below are illustrated the floorman's standard hand signals.

The crane operator should always open the main line switch when he leaves the crane. He should always sound his warning signal or gong as an alarm when carrying loads with the crane. He should report, immediately, any adjustments that should be made on the crane to the foreman. He should regularly test the brakes, limit switch, and controls before he starts his "shift" on the crane.

Crane operators should never move any load except upon signal from one floorman. He should never drag slings, hooks, or loads along the floor with the crane. He should never permit anyone to make adjustments or repairs before he pulls the main line switch and locks it open. He should never operate a crane when he knows that adjustments should be made to it, and he should never hold a circuit breaker closed if it opens, or place wire or copper bars in the fuse box if fuses blow out.

FLOORMAN'S STANDARD HAND SIGNALS

1. HOIST. The floorman makes small circles with his hand with his index finger extended and his forearm in a vertical position.

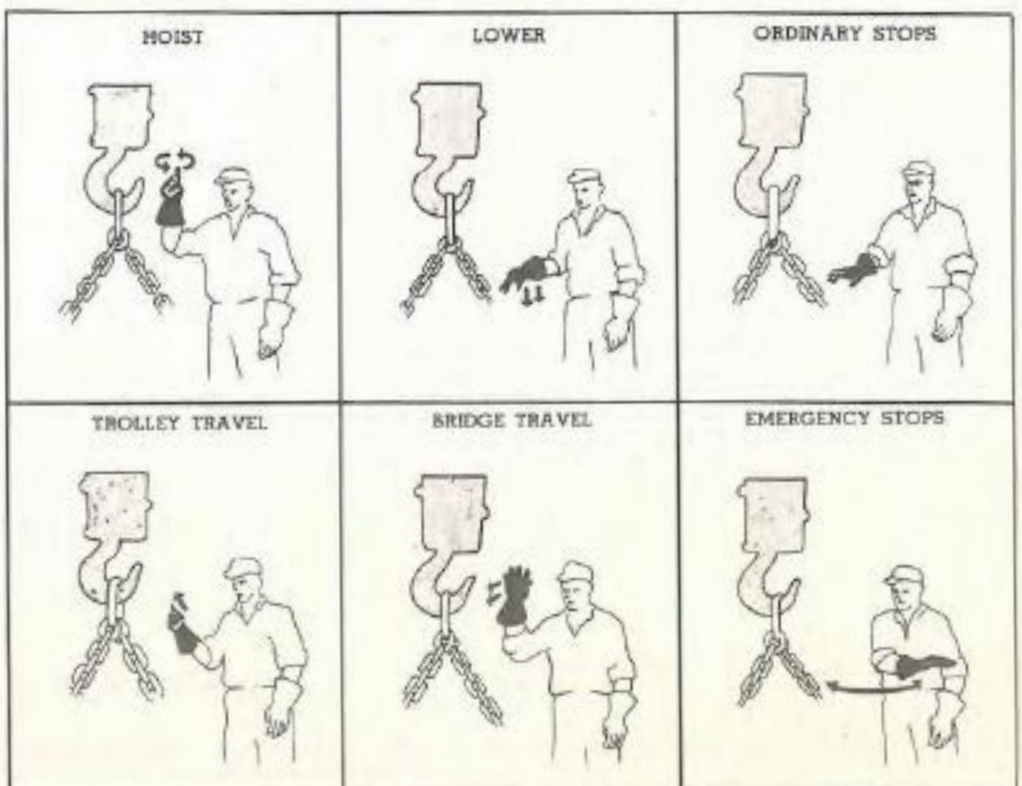
2. LOWER. The floorman, with his hand open and forearm extending downward below the hip, waves to indicate downward movement.

3. STOP. The floorman, with his hand level with his hip, extends and holds his arm rigid.

4. TROLLEY TRAVEL. The floorman extends his arm just above his hip with fingers closed and thumb extended and indicates direction with his thumb, in the same way he would "thumb a ride."

5. BRIDGE TRAVEL. The floorman, with his hand open and with his palm facing the direction of travel and forearm vertical, indicates direction of travel by waving his arm.

6. EMERGENCY STOP. The floorman extends his arm with hand level with his hip and palm downward and moves his hand quickly to right and left.



MODERNIZING OLD CRANES

CRANES, unlike much other machinery, lend themselves to modernization, but because, by the replacement of parts as they wear, they continue to give service equal to that given when new, many plants continue to accept these operating characteristics in spite of today's faster tempo in the production process. If a crane was originally of sound design and the basic structure is now in good condition, the crane can usually be modernized to meet today's tempo. The degree with which its performance can be improved depends entirely upon the additional investment the owner is willing to make in his crane.

In principle, should it be determined that if the cost to completely modernize a crane is more than 40% of its replacement cost, then it would be better to replace the old crane with a new one of modern design.

In any modernization program, the trolley of the crane should receive paramount consideration, because, in general, old cranes have much slower hoisting speeds than those of present day cranes, less efficient braking, and few if any safety features. The replacement of the old trolley with one of modern design is an improvement that speeds operations, substantially reduces maintenance cost and gives improved crane performance. This is a major improvement that can be made without any changes to the bridge structure and for a reasonable investment.

If the need exists to handle many light loads, another improvement that may be easily and inexpensively made is to install a quick acting auxiliary hoist on the old crane trolley and restrict the use of the old hoisting mechanisms to handling heavy loads where speed usually is unimportant A standard commercial type hoist, such as a Shaw-Box "Load Lifter" hoist attached to the trolley, makes available a good quick acting auxiliary hoist at comparatively small investment.

Also, there are available complete high speed auxiliary hoist units termed "wheelbarrow" trolleys that may be coupled to any existing crane trolley. These are standard high speed heavy duty crane hoisting mechanisms.

INCREASING SPEEDS AND CAPACITIES

Characteristic of cranes more than 15 years old is their slow operating speeds, particularly of the bridge and hoist motions. With the faster tempo prevalent in industry, there has been a gradual increase in crane speeds. A "lively" crane speeds up operations in the entire shop—a "sluggish" one retards it.

In many cases, it is possible to appreciably increase speeds of existing cranes at reasonable cost. Increased bridge speeds contribute much toward increased utility of a crane. Usually, the bridge speed of an old crane may be increased as much as 25%, without the necessity of installing a larger motor, by a simple change in the ratio in the motor pinion and motor gear. By checking the motor sizes and gear ratios with the formulae in Section VI, the possible increase in bridge speed may be easily determined. Ordinarily, little, if anything, is gained by increasing trolley speeds, as under normal operation the majority of trolley movement takes place while the bridge is traveling.

To increase the hoisting speed of a crane, if its original capacity is retained, it is necessary to install a motor of larger size and change either the gear ratio in the hoisting gearing or change the rope reeving. Frequently, a motor of larger horsepower at a higher R.P.M. will interchange with the old motor and give the higher speed without any other changes. A practice quite commonly followed in increasing hoisting speeds in old cranes is to increase the speed to that required and decrease the rated capacity of the crane by simply changing the rope reeving. For example, if a crane now rated at 15 tons capacity has six parts of rope and a speed of 20 feet a minute, by changing the rope reeving to four parts of rope, the hoist speed would automatically become 30 feet a minute and the maximum capacity of the crane would become 10 tons.

Frequently, because of design and production practices of crane builders, more so in the past than the present, old cranes, if they are sound in structure, may be converted to heavier than originally rated capacity. Often only slight modifications are required, but, if a general rebuilding is necessary, then a careful cost analysis should be made before the project of increasing the capacity of the crane should be undertaken. From the information contained in Section VI, each part of the crane may be checked for strength. Likewise, the changes and reinforcements that may be necessary may be determined. The principal points that should be carefully considered during the check are the end trucks, rope sizes, lower block and hook, equalizing sheaves and pins, wheel axle and bearings, gear sizes, and motors.

CHANGES TO OLD CRANES TO REDUCE MAINTENANCE COST

Frequently the cost to maintain an old crane may be materially reduced and its operation improved by replacing worn parts or units with similar units of modern design. Many such units may be applied to any crane at a cost comparable with that of the parts they replace. Those suggested below are units and parts that each contribute much to better performance and lower maintenance cost of the modern crane, and they may be installed on cranes of any make or vintage.

HYDRAULIC BRIDGE BRAKES Frequently, the old style mechanically operated bridge brake, in addition to being ineffective is the cause of excessive wear on the crane bearings and wheels and contribute much to motor burn-outs. A modern hydraulic bridge brake would reduce maintenance cost on the bridge and improve operation. The installation of a modern hydraulic bridge brake is comparatively simple and inexpensive.

HOIST BRAKES Obsolete brakes are not only dangerous, but are the cause of much maintenance expense. Increased safety, better control of the load, and reduced operating costs are obtainable by installing modern magnetic and mechanical brakes on alternating current cranes; and on direct current cranes, better control in lowering may be obtained by discarding the old magnetic and mechanical load brakes and installing a modern magnetic brake and new dynamic braking controller and employing dynamic braking for lowering.

MOTORS AND CONTROLLERS If the maintenance of motors and controllers are one of the major items in crane maintenance cost, and basic structure and mechanism of the crane is in good condition, then savings in maintenance and improved operation usually will justify the cost of new motor and control equipment. Frequently, just the replacement of worn motor bearings which contribute much to the excessive wear in gears and damage to motor windings will contribute considerable savings in maintenance. Likewise, frequently the replacement of a few burned contacts or fingers in the controller will save much time-out-of-service and subsequent expense.

DOUBLE COLLECTOR SYSTEM One minor trouble that causes "tie-ups" and consumes the maintenance man's time is improper contact with the current supply. This condition may be corrected inexpensively with a great maintenance saving by installing the double collector system of taking current from the runway wires.

HARDENED PINIONS The replacement of all pinions with heat-treated hardened pinions that have twice the strength and two to three times longer life is an inexpensive improvement that may be made to any crane.

LIMIT SWITCHES Damage to the hoisting trolleys, sheaves, and wire rope, and accidents can be prevented by installing a positive modern limit switch to prevent "double blocking."

SPRING BUMPERS Damage to trolley wheels, gears, bearings, and electrical equipment caused by the trolley bumping against solid rail stops on the bridge can be minimized by installing spring bumpers on the crane bridge. They relieve the mechanisms from unnecessary shock and impact, and consequently less maintenance is required.

TAPER TREAD TRUCK WHEELS

One sure way to increase the life of bridge truck wheels, reduce wear on crane rails, and, if the bridge is of sound design, keep it square on the track, is to install taper tread truck wheels. The operation and advantages of taper tread wheels are described and graphically illustrated in Section V of this book. Not only do taper tread wheels last longer, but by relieving the driving mechanism from excessive strain, the wear on the entire bridge drive machinery is reduced. Taper tread wheels may be installed in a crane for approximately the same cost as the wheels that they replace and at a much lower cost than wheels of special composition.