The New Continuous Strip Mill of the Trumbull Steel Company

A General Description of the New 14-in. Hot Strip Mill Which Will Be Ready for Operation About June 1—Capacity of New Mill 140 to 600 Tons per Day.

THE plant of the Trumbull Steel Company will be augmented about June 1 by a new unit which is designed to roll intermediate sizes of bands, hoops and strips varying from 2½ x .045 in. to 7 x .060 in. and thicker up to ¼ in. The finished product may be coiled or cut to lengths. This mill is an electrically driven, continuous mill with a continuous furnace heated by electric gas. The capacity of the new unit will vary from 140 to 160 tons per day, depending on the size of material rolled, and will fit in with the other mills of the strip department which consists of a 16-in. continuous mill, a 9-in. continuous mill, and a cold rolling department having 35 stands or rolls arranged single and in trains varying from two to four stands. The new mill was constructed by the Morgan Construction Company of Worcester, Mass., and is being erected by the steel company under the combined direction of Mr. Frederick Wille, consulting engineer of the Trumbull Steel Company, and the Morgan Construction Company.

Building.

This unit is housed in a steel building 1,200 ft. long and 100 ft. wide, consisting of 60 bays 20x100 ft. The roof is 1/5 pitch double monitor type with continuous sliding wood sash on the lower part and continuous louvres on the upper part. The roof truss elevation is 33 ft. above the floor line. This building forms a continuation of the 16-in. mill building parallel to the 9-in. mill building and the pickling building and is easily accessible to the cold rolling department. The building is served by two 15-ton cranes mounted on 60-lb. A.S.C.E. rails. One crane is a three-motor single trolley double hook type with 50-hp. bridge motor, 10-hp. trolley motor and 50-hp. mainhoist motor; the bridge travel speed is 40 fpm., the trolley travel speed 175 fpm. and the hoist-lift 30 fpm. The other crane is a four-motor single hook type with 10-ton auxiliary hoist, the auxiliary hoist motor is 30 hp. and the other features are similar to the first crane. The six bays at the north end of the building will be used for a billet yard and will permit the storage of three 30x60-ft. billet piles; 24 bays in the middle of the building will be devoted to the rolling mill with its furnace, motor-room, conveyors, etc., and the south half of the building will be used for the handling and storage of finished products.

Billet Yard.

The billet yard will be equipped with a 30-ton scale at the floor level, having 24-ft. platform and cradles for weighing billets and, also, with five cast iron billet skids which feed billets to charging conveyors. Dimensions: north end of building to first skid 143 ft. 5 in., from center line to center line of skids 6 ft. 8 in., center line charging conveyor to back of skids 17 ft. 8¼ in., floor line to top of skids (high end) 12¾ in.

Heating Furnace.

Morgan recuperative type of continuous heating furnace, using producer gas as fuel. This producer gas is developed in a producer gas plant situated west of the 9-in. mill; this plant serves both the 9-in. mill and the 14-in. mill furnaces. The producer gas plant is equipped with two Morgan and two Hughes gas producers. The heating furnace for the 14-in. mill has a Slick suspended roof, 11 cast iron water-cooled skids, magnesite brick on bottom of 4 ft. 6 in. inclined hearth and all of horizontal hearth. The air-exhaust is No. 9 monogram (Sturtevant) driven by 17½-hp. shunt wound motor. Dimensions: center line furnace to center line north end of building 210 ft., brickwork 34 ft. 2 in. wide by 37 ft. 2 in. long, center line of mill to discharge end of brickwork 6 ft. 2 in., center line of mill to charging end of brickwork 31 ft., width of hearth 32 ft., water-cooled skids 4 ft. wide by 7 ft. 7 in. long, spaced 2 ft. 7½ in. center to center, length of brick hearth 27 ft. 9½ in., 24 steel skids 2½ in. by 9 in. by 15 ft. long spaced 13½ in. center to center in brick hearth, slope of hearth 1:5, length of inclined hearth, measured horizontally, 22 ft. 5½ in., length of horizontal hearth 5 ft. 4 in.

The furnace has the following equipment: An external charging conveyor with an over-all length of 36 ft. 3½ in., supported by six cast iron stands having seven hollow cast iron rollers 15 in. in diameter by 18 in. long, which have a peripheral speed of 460 fpm.; from the face of furnace brickwork to center line of last roller 5 ft. 7½ in. and from floor line to top of rollers 7 ft. 11½ in. An internal charging conveyor consisting of five water-cooled rollers inside of the bearing furnace, with roll shafts inclined at an angle of 87 deg. with furnace and line of billet travel. The rollers of both the external and internal charging conveyors are driven by one 12-hp. dc. motor, the internal rollers being driven from the outside of the furnace by a line shaft and helical gears. Internal rollers are 8 in. in diameter by 14 in. long, the end 3½ in. of rollers tapering down to 6 in. in diameter. The peripheral speed of rollers is 96 fpm. Morgan type of cross pusher having five steel pusher arms, operated by cranks on line shaft which is operated by a bell crank connected to the piston of a steam cylinder, with the entire cross pusher bolted to furnace buckstays. Dimensions: pusher arms 1¾ in. by 5½ in. by 3 ft. 7 in., crank shaft 27 ft. 4½ in. long by 6 15/16 in. diameter, steam cylinder 25 in. diameter by 2 ft. 7 11/16 in. long. Hawthorne type of push-out rolls; over hand pinch rolls 11 3/16 in. diameter by 10 in. long with a peripheral speed of 330 fpm., driven through gear reduction by 12-hp. dc. motor. Pull-out rolls with rolls, roll drive and top roll lifting mechanism bolted to the furnace steel work; the bottom roll, which is 10 in. in diameter by 2 ft. 5½ in. long, is driven through spur

gear reduction by 5-hp. dc.
mechanism is operated thro
2hp. dc. motor. The top ro
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89 fpm.

Roughing Mill Roll Train.

The roughing mill roll t
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emergency shear, 16-in. edg
1-in. edging mill, two stands
flying shear.

The roll stands are two
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roll bearing is adjusted by w
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in diameter from 13.86 in.
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in diameter by 13 in. long;
by 5½ in. long.

The emergency shear i
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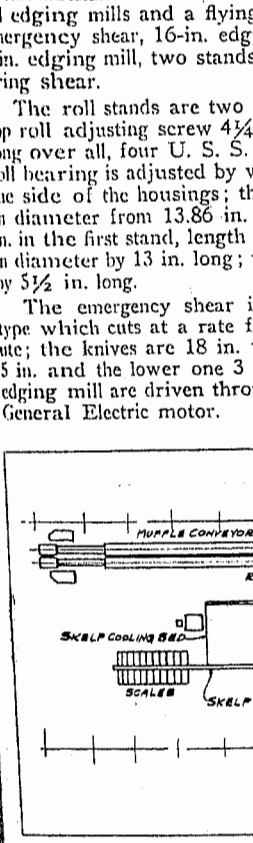
5 in. and the lower one 3
edging mill are driven thro
General Electric motor.



The fling shear is an
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mill 4 ft. 5¼ in., 12-in.
8 ft. 9¾ in., third to fou

Intermediate Roll Train

This train consists o
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mill. The rolls are cast
and vary in diameter fr

gear reduction by 5-hp. dc. motor; the top roll lifting mechanism is operated through a worm reduction by a 2-hp. dc. motor. The top roll is 10 in. diameter by 2 ft. 8 in. long. The bottom roll has a peripheral speed of 89 fpm.

Roughing Mill Roll Train.

The roughing mill roll train consists of four stands of horizontal rolls with an emergency shear, three vertical edging mills and a flying shear arranged as follows: emergency shear, 16-in. edging mill, two stands or rolls, 1-in. edging mill, two stands rolls, 12-in. edging mill and flying shear.

The roll stands are two high with open top housings, top roll adjusting screw 4¼ in. diameter by 3 ft. 3½ in. long over all, four U. S. S. threads per inch; the bottom roll bearing is adjusted by wedges operated by screws on the side of the housings; the rolls are cast steel varying in diameter from 13.86 in. in the fourth stand to 12.54 in. in the first stand, length of body is 16 in., necks 10 in. in diameter by 13 in. long; wabblers are 9 in. in diameter by 5½ in. long.

The emergency shear is the Edwards up-and-down type which cuts at a rate from 7 to 29 strokes per minute; the knives are 18 in. wide, the upper one traveling 5 in. and the lower one 3 in.; this shear and the 16-in. edging mill are driven through a gear drive by a 140-hp. General Electric motor.

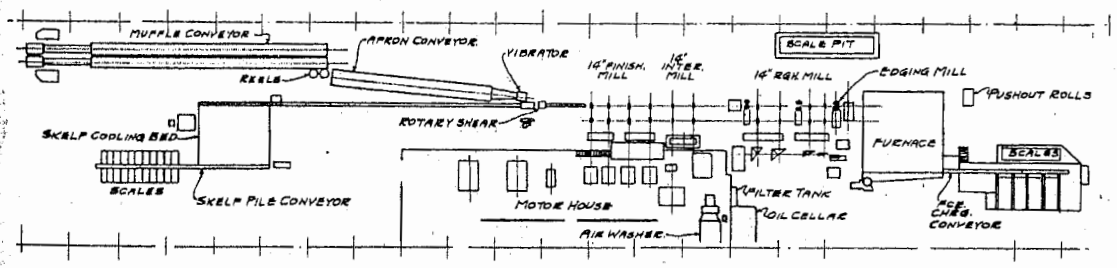

Fig. 1—General layout 14-in. hot strip mill.

The fling shear is an Edwards steam operated type; the width of the knives is 10 in. and the diameter of the steam cylinder is 12 in.

The following dimensions apply to the roughing mill train: center line of roughing mill train to center line of west building columns 36 ft. 6 in., face of furnace brickwork to center line of emergency shear 5 ft. 6 in., floor line to center line of emergency shears 2 ft. 7 in., face of furnace brickwork to 16-in. edging mill 8 ft. 10½ in., center line of edging mill to center line first roll stand 4 ft. 7½ in., center line first roll stand to center line second roll stand 6 ft., second rolling stand to 12-in. edging mill 4 ft. 5¼ in., 12-in. edging mill to third roll stand 8 ft. 9¾ in., third to fourth 9 in.

Intermediate Roll Train.

This train consists of two stands of rolls, the fifth and sixth with the same roll housings as the roughing mill. The rolls are cast iron chilled to 13 in. in diameter and vary in diameter from 13.6 in. to 13.2 in.; all the other roll dimensions are the same as those of the roughing mill. From the center line of the fourth stand in the roughing train to the center line of the fifth stand in the intermediate train is 27 ft. 6 in.; from the center line of the fifth stand to the center line of the sixth stand is 9 ft. The two roll stands in the intermediate train are driven by a 1,250-hp. General Electric motor, which is connected directly to the sixth stand and to the fifth stand by a train of spur gears.

Finishing Mill Roll Train.

The roll housings of this train are the same as those of the roughing and intermediate roll mills. The rolls are cast iron clear chilled to 13 in. in diameter and vary in diameter from 14.4 in. to 13.6 in. The roll stands are spaced on their center lines as follows: from the sixth to the seventh 9 ft., from the seventh to the eighth 9 ft., from the eighth to the ninth 8 ft. 3 in., from the ninth to the tenth 7 ft. 6 in. The roll diameters in this train are so graduated that, when ground too small for one stand, a roll may be used in the next stand back. Each finishing mill stand is driven by an individual 800-hp. General Electric motor directly connected to the top pinion.

Equipment for Handling Finished Material.

Beyond the finishing roll train are guide troughs for guiding material to either the rotary shear or the vibrator; if the strip is to be shipped in lengths it goes to the rotary shear; if it is to be shipped in coils it goes to the vibrator. The guide trough to the rotary shear is straight and has an over-all length of 16 ft. 6½ in.; two widths are provided, 6 in. and 9 in.; they consist of two 8-in. side channel, 10 cast iron bottom plates and five steel cover-plates. The guide trough to the vibrator first twists the material to the vertical and then turns on a 10-ft. radius to an angle of 14 deg. and 18 min. and delivers material to pinch rolls at the vibrator.

Beyond the finishing mill train is a rotary shear designed to cut strip into lengths varying from 12 ft. to 30 ft.; this shear, which is placed 22 ft. from the center line of the tenth roll, is equipped with two knives 8 in. wide on each rotating shaft and is driven by a 4-in. double belt. Between the final belt and the line shaft are two belts running on four conical pulleys. The line shaft, which is used in common by the rotary shear and the vibrator, is driven by a 5-in. double belt running on a pulley on the tenth roll stand lead spindle. From the rotary shear a Morgan skelp conveyor carries the cut

lengths to the cooling bed which consists of 43 cast iron rollers 10 in. in diameter and 8 in. long. The rollers are fastened to 1 3/16-in. diameter shafts by two set screws; the peripheral speed of the rollers vary from 170 to 510 fpm.; this conveyor is belt driven through one gear reduction by a 10-hp. General Electric motor. Dimensions: center line rotary shear to center line double pulley 4 ft. 5 in., double pulley to first roller 15 ft., center line to center line of rollers 2 ft. 6 in., floor line to top of first roll 2 ft. 8½ in., floor line to top of last roll 5 ft. 2 in. The conveyor terminates in two piling rolls 10 in. in diameter by 8 in long, with a peripheral speed varying from 246 to 738 fpm.; from the center line of the last table roller to the center line of piling rolls is 4 ft. 4 in.; the piling rolls are driven by a 5½-hp. General Electric motor.

The cooling bed is a Morgan skelp type with reciprocating dogs. From the center line of the rotary shear to the cooling bed is 116 ft. 2 in.; the width of the cooling bed from the center line of the skelp conveyor to the center line of the pile conveyor is 28 ft. 5 in.; the length is 30 ft. 6 in. There are eight lines of dogs spaced 16 in. apart with a stroke of 18½ in.; the stroke of the skelp conveyor kick-off is 22⅛ in.; the dogs and kick-off are operated through clutches from the same gear reduction driven by a 20-hp. General Electric motor. Piles of cut lengths are tied before leaving the cooling bed.

The pile conveyor conveys the tied piles to twin scales; this conveyor consists of 13 cylindrical rollers 15 in. in diameter by 12 in. long, and 11 double conical rollers 13 in. long with 15-in. center diameter and 10¾-in. end diameters. The double conical rollers are arranged to dump on either side on the twin scales; their peripheral speed is 66 fpm.; they are belt driven from a drop pulley driven through worm reduction by a 10-hp. dc. motor. From the center line of the cooling bed to the center line of the scales is 31 ft. 9 in. The scales have a capacity of 30 tons; their platforms are 30 ft. long and there are 11 cast iron storage bins for each scale.

From the guide troughs material which is to be shipped in coils goes to the vibrator; this is a device for distributing strip in a serpentine form upon an apron conveyor. Strip is driven through the vibrator by two pinch rolls 14 in. in diameter by 5½ in. long, having peripheral speed varying from 1130 to 2260 fpm. The vibrator itself may have from 110 to 220 vibrations per minute with variable lengths of vibrations; it is driven by an eccentric, which in turn is driven by a belt from the same line shaft as the rotary shear. From the center line of the tenth roll to the center line of the vibrator is 30 ft. 3½ in.; from the center line of the mill to the center line of the vibrator is 3 ft. 10 in. The apron conveyor takes the strip in a serpentine form from the vibrator to the reels and acts as a cooling bed; it is driven through a reduction gear by a 10-hp. dc. motor. Dimensions: vibrator to foot shaft 10 ft. 3 in., foot shaft to head shaft 70 ft. 1½ in., floor line to top of conveyor at foot shaft 2 ft. 4¾ in., at head shaft 2 ft. 1 in. At the head shaft of the apron conveyor are two reels for coiling the strip; these reels have collapsible cores raised and lowered by link crank rod and eccentric driven by individual 15-hp. dc. motor. The reels themselves are driven by individual 15-hp. dc. motors, with speed varying from 72 to 288 rpm. and are equipped with a pull-over device for transferring coils to the muffle conveyor; this pull-over consists of a 1¼-in. square bar 14 in. long suspended by I-beam monorail and having a dog on one end to hook coils; this bar is driven forward and back by motor operated pinch rolls with a speed of 30 rpm.; the pinch rolls are driven through worm reduction by 12-hp. dc. motor. Dimensions: center line of vibrator to center line reels 88 ft. 9 5/16 in., center line mill to center line 4 ft. 6 in., diameter of collapsible cores 20½ in., diameter of revolving top 3 ft. 9 in., diameter of pinch rolls 9½ in.

Two muffle conveyors of the chain and dog type, located side by side, receive coils from reels and convey them through a partially deoxidized atmosphere and deliver them to trucks; the muffle effect is secured by water-cooled covered plates. At the end of main conveyor, short inclined chain conveyors lower the coils onto trucks; each conveyor is driven through gear reduction by a 12-hp. ac. motor. Dimensions: center line reels to the nearest conveyor 4 ft. 9 in., conveyors center line to center line 5 ft. 9 in., center line conveyors to center line of building columns 12 ft. 2½ in. Speed of chain 350 fpm. Length of conveyor, center line of reels to center line of head shaft, 116 ft. 4 3/16 in.

Motor-Room.

The motor-room is located in the mill building on the east side, 260 ft. from the north end columns with a length of 140 ft. and a width of 43 ft. 9¾ in. The walls are brick and the roof is of corrugated sheeting, removable to admit crane hooks into motor-room. All mill driving motors, two 2,300-kw. motor generator sets, exciter, and a Spracco air washer are in the motor-room.

Electric Equipment.

The electric equipment is all furnished by the General Electric Company. The roughing stand and the intermediate stand are driven by two 1,250-hp. 175-350 rpm. dc. motors. The last four stands, which constitute the finishing mill, are each driven by 800-hp. dc. motors, with speed varying from 200 rpm. to 250 rpm. These motors obtain their power at 600 volts, dc., from two motor-generator sets, type MCF 12, 450 rpm., 600 volts, 2,300 kw. compound wound, each driven by a 3,300-kva. 450-rpm. 220-volt motor.

CORROSION OF FERROUS METALS

A paper was read before the Institution of Civil Engineers, in which the author, Sir Robert A. Hatfield, referred to tests made with fourteen different types of ferrous metals. They included irons (rolled and forged), carbon steels, special steels, and cast irons, and were represented 1,330 separate specimens, 24 in. x 3 in. x ½ in.

The tests were carried out on a total number of 182 test-pieces, and particulars of the tests are given. The nature, chemical composition and other qualities were discussed, and in the case of non-rusting steel, the resistance to corrosion, when constantly wetted by sea-spray, depends upon its physical constitution.

The author discussed the various theories of corrosive action, and the addition of copper to steel, for the purpose of preventing or mitigating corrosion, was not generally advised. Examples were given of special steels possessing great resistance to corrosion, and specimens of historical interest were described.