Fig. II. is a perspective view of the conveyer, as it lies in its troughs, at work; and shows the manner in which it is joined to the pulleys, at each side of the elevator.

Fig. III. exhibits a view of the pulley of the meal elevator, as it is supported on each side, with the strap and buckets descending to be filled.

Fig. IV. is a perspective view of the under side of the arms of the hopper-boy, with flights complete. The dotted lines show the track of the flights of one arm; those of the other following, and tracking between them. A A are the sweepers. These carry the meal round in a ring, trailing it regularly all the way, the flights drawing it to the centre, as already mentioned. B B are the sweepers that drive it into the bolting hoppers.

Fig. V. is a perspective view of the bucket of the wheat-elevator; and shows the manner in which it is fastened, by a broad piece of leather, which passes through and under the elevator-strap, and is nailed to the sides with little tacks.

CHAPTER XI.

OF THE CONSTRUCTION OF THE SEVERAL MACHINES.

ARTICLE 95.

OF THE WHEAT ELEVATOR.

To construct a wheat-elevator, first determine how many bushels it should hoist in an hour, and where it shall be set, so as, if possible, to answer all the following purposes:—

1. To elevate the grain from a wagon or ship.
2. From the different garners into which it may be stored.
3. If it be a two-story mill, to hoist the wheat from the tail of the fan, as it is cleaned, to a garner over the stones.
4. To hoist the screenings, to clean them several times.

5. To hoist the wheat from a shelling-mill, if there be one.

One elevator may effect all these objects in a mill rightly planned, and most of them can be accomplished in mills ready built.

Suppose it be wished to hoist about 300 bushels in an hour, make the strap $4\frac{1}{2}$ inches wide, of good, strong, white harness leather, in one thickness. It must be cut and joined together in a straight line, with the thickest, and, consequently, the thinnest ends together, so that if they be too thin, they may be lapped over and doubled, until they are thick enough singly. Then, to make wooden buckets, take the but of a willow or water birch, that will split freely; cut it in bolts, 15 inches long, and rive and shave it into staves, $5\frac{1}{2}$ inches wide, and three-eighths of an inch thick; these will make one bucket, each. Set a pair of compasses to the width of the strap, and make the sides and middle of the bucket equal thereto at the mouth, but let the sides be only two-thirds of that width at the bottom, which will make it of the form of fig. 9, Plate VI.; the ends being cut a little circular, to make the buckets lie more closely to the strap and wheel, as it passes over. Make a pattern of the form of fig. 9, by which to describe all the rest. This makes a bucket of a neat form, to hold about 75 solid inches, or somewhat more than a quart. To make them bend to a square at the corners e c, cut a mitre square across where they are to bend, about 2-8ths through; boil them and bend them hot, tacking a strip of leather across them, to hold them in that form until they get cold, and then put bottoms to them of the thin skirts of the harness leather. These bottoms are to extend from the lower end to the strap that binds it on. To fasten them on well, and with despatch, prepare a number of straps, $1\frac{3}{4}$ inches wide, of the best cuttings of the harness leather; wet them and stretch them as hard as possible, which reduces their width to about $1\frac{1}{2}$ inches. Nail one of these straps to the side of a bucket, with 5 or 6 strong tacks that will reach through the bucket, and clinch inside. Then take a $1\frac{1}{2}$ inch chisel, and strike it through the main strap

about a quarter of an inch from each edge, and put one end of the binding-strap through the slits, draw the bucket very closely to the strap, and nail it on the other side of the bucket, which will finish it. See B in fig. 2, Plate VI. C is a meal-bucket fastened in the same manner, but is bottomed only with leather at the lower end, the main strap making the bottom side of it. This is the best way I have yet discovered to make wooden buckets. The scraps of the harness leather, out of which the elevator-straps are cut, are generally about enough to complete the buckets.

To make Sheet-Iron Buckets.

Cut the sheet in the form of fig. 8, Plate VI., making the middle part c, and the sides, a and b, nearly equal to the width of the strap, and nearly $5\frac{1}{2}$ inches long, as before. Bend them to a right angle at every dotted line, and the bucket will be formed :—c will be the bottom side next to the strap; and the little holes a a and b b will meet, and must be riveted to hold it together. The two holes c are for fastening it to the straps by rivets. The part a b is the part that dips up the wheat, and the point, being doubled back, strengthens it, and tends to make it wear well. The bucket being completely formed, and the rivet holes made, spread one out again, as fig. 8, to describe all the rest by, and to mark for the holes, which will meet again when folded up. They are fastened to the strap by two rivets with thin heads put inside the bucket, and a double burr of sheet iron put on the under side of the strap, which fastens them on very tightly. See A, fig. 2, Plate VI. These buckets will hold about 1,3 quarts, or 88 cubic inches. This is the best way I have found to make sheet-iron buckets. D is a meal-bucket of sheet-iron, riveted on by two rivets, with their heads inside the strap; the sides of the buckets are turned a little out, and holes made in them for the rivets to pass through. Fig. 11 is the form of one spread out, and the dotted lines show where they are to be bent at right angles to form them. The strap forms the bottom side of these buckets.

Make the pulleys 24 inches in diameter, as thick as the strap is wide, and half an inch higher in the middle than at the sides, to make the strap keep on; give them a motion of 25 revolutions in a minute, and put on a sheet-iron bucket for every 15 inches; then 125 buckets will pass per minute, which will carry 162 quarts, and hoist 300 bushels in an hour, and 3600 bushels in 12 hours. If you wish to hoist faster, make the strap wider, the buckets larger in proportion, and increase the velocity of the pulley, but not to above 35 revolutions in a minute, nor place more buckets than one for every 12 inches; otherwise, they will not empty well. A strap of 5 inches, with buckets 6 inches long, and of a width and proportion suiting the strap, (4½ inches wide,) will hold 1,8 quarts each; and 35 revolutions of the pulley will pass 175 buckets, which will carry 315 quarts in a minute, and 590 bushels in an hour. If the strap be 4 inches wide, and the wooden buckets 5 inches deep, and in proportion to the strap, they will hold ,8 of a quart: then, if there be one for every 15 inches, and the pulley makes 27 revolutions in a minute, it will hoist 200 bushels in an hour. Where there is a good garner to empty the wheat into, this is the size they are commonly made, and is sufficient for unloading wagons.

Plate VI., Fig. 6, represents the gudgeon of the lower pulley; fig. 7, the gudgeon for the shaft on which the upper pulley is fixed. Fix both the pulleys in their places, but not firmly, so that a line, stretched from one pulley to the other, will cross the shafts or gudgeons at right angles. This must always be the case to make the straps work fairly. Put on the strap with the buckets; draw it tightly, and buckle it; put it in motion, and if it do not keep fairly on the pulleys, their position may be altered a little. Observe how much the descending strap swags by the weight of the buckets, and make the case round it so curved, that the points of their buckets will not rub in their descent, which will cause them to wear long and work easily. The side boards need not be made crooked in dressing out, but may be bent sufficiently by sawing them half way, or two-thirds, through, beginning

at the upper edge, holding the saw very much aslant, the point downwards and inwards, so that in bending, the parts will slip past each other. The upper case must be nearly straight; for if it be made much crooked, the buckets will incline to turn under the strap. Make the cases 3-4ths of an inch wider inside, than the strap and buckets, and $1\frac{1}{2}$ inches deeper, that they may play freely; but do not give them room to turn upside down. If the strap and buckets be 4 inches, then make the side boards $5\frac{1}{2}$, and the top and bottom boards $6\frac{3}{4}$ inches wide, of inch boards. Be careful that no shoulders nor nail-points be left inside of the cases, for the buckets to catch in. Make the ends of each case, where the buckets enter as they pass over the pulleys, a little wider than the rest of the case. Both the pulleys are to be nicely cased round to prevent waste, not leaving room for a grain to escape, continuing the case of the same width round the top of the upper, and bottom of the lower pulley; then, if any of the buckets should ever get loose, and stand askew, they will be kept right by the case; whereas, if there were any ends of boards or shoulders, they would catch against them. See A B, fig. 1, Plate VI. The bottom of the case of the upper pulley must be descending, so that what grain may fall out of the buckets in passing over the pulleys, may be guided into the descending case. The shaft passing through this pulley is made round where the case fits to it: half circles are cut out of two boards, so that they meet and embrace it closely. The undermost board, where it meets the shaft, is ciphered off inside next the pulley, to guide the grain inward. But it is full as good a way to have a strong gudgeon to pass through the upper pulley, with a tenon at one end, to enter a socket, which may be in the shaft, that is to give it motion. This will suit best where the shaft is short, and has to be moved to put the elevator out of, and into gear.

The way that I have generally cased the pulleys is as follows; namely: The top board of the upper strap-case, and the bottom board of the lower strap-case, are extended past the lower pulley to rest on the floor; and the

lower ends of these boards are made two inches narrower, as far as the pulley-case extends; the side-board of the pulley is nailed, or rather screwed, to them, with wooden screws. The rest of the case boards join to the top of the pulley-case, both being of one width. The block, which the gudgeons of this pulley run in, is screwed fast to the outside of the case boards; the gudgeons do not pass quite through, but reach to the bottom of the hole, which keeps the pulley in its place.

The top and bottom boards, and, also, the side-boards of the strap-cases, are extended past the upper pulley, and the side-boards of the pulley-case are screwed to them; but this leaves a vacancy between the top of the side-boards of the strap-cases, and shoulders for the buckets to catch against, and this vacancy is to be filled up by a short board, guiding the buckets safely over the upper pulley. The case must be as close to the points of the buckets, where they empty, as is safe, that as little as possible may fall down again. There is to be a long hole cut into the case at B, for the wheat to fall out at, and a short spout guiding it into the crane spout. The top of the short spout next B, should be loosely fastened in with a button, that it may be taken off, to examine if the buckets empty well, &c. Some neat workmen have a much better way of casing the pulleys, which is not easily described; what I have described is the cheapest, and answers very well.

The wheat should be let in at the bottom, to meet the buckets; and a gate should shut as near to the point of them as possible, as at A, fig. 1, Plate VI. Then, if the gate be drawn sufficiently to fill the buckets, and the elevator be stopped, the wheat will stop running in, and the elevator will be free to start again; but if it had been let in any distance up, then, when the elevator stopped, it would fill from the gate to the bottom of the pulley, and the elevator could not start again. If it be, in any case, let in at a greater distance up, the gate should be so fixed that it cannot be drawn so far as to let in the wheat faster than the buckets can take it, else the case will fill and stop the buckets. If it be let in faster at the

hindmost side of the pulley than the buckets will carry it, the same evil will occur; because the buckets will push the wheat before them, being more than they can hold, and give room for too much to come in; therefore, there should be a relief gate at the bottom, to let the wheat out, should too much happen to get in.

The motion is to be given to the upper pulley of all elevators, if it can be done, because the weight in the buckets causes the strap to hang tightly on the upper, and slackly on the lower pulley; therefore, the upper pulley will carry the greatest quantity without slipping. All elevators should stand a little slanting, because they will discharge the better. The boards for the cases should be of unequal lengths, so that two joints may never come close together; this greatly strengthens the case. Some have joined the cases at every floor, which is a great error. There must be a door in the ascending case, at the place most convenient for buckling the strap, &c. &c.

Of the Crane Spout.

To make a crane spout, fix a board 18 or 20 inches broad, truly horizontal, or level, as a, under B, in fig. 1, Plate VI. Through the middle of this board the wheat is conveyed, by a short spout, from the elevator. Then make the spout of 4 boards, 12 inches wide at the upper, and about 4 or 5 inches at the lower end. Cut the upper end off aslant, so as to fit nicely to the bottom of the board; hang it to a strong pin, passing through the broad board near the hole through which the wheat passes, so that the spout may be turned in any direction, and still cover the hole, at the same time it is receiving the wheat, and guiding it into any garner, at pleasure. In order that the pin may have a strong hold of the board and spout, there must be a piece of scantling, 4 inches thick, nailed on the top of the board, for the pin to pass through; and another to the bottom, for the head of the pin to rest on. But if the spout be long and heavy, it is best to hang it on a shaft, that may extend down to the floor, or below the collar-beams, with a pin through it, as x, to

turn the spout by. In crane spouts for meal, it is sometimes best to let the lower board reach to, and rest on the floor. If the elevator-cases and crane spout be well fixed, there can neither grain nor meal escape, or be wasted, that enters the elevator, until it comes out at the end of the crane-spout again.

*Of an Elevator to elevate Wheat from a Ship's Hold.**

Make the elevator complete (as it appears 35—39, Plate VIII.) on the ground, and raise it to its place afterwards. The pulleys are to be both fixed in their places and cased; and the blocks that the gudgeon of the upper pulley is to run in, are to be riveted fast to the case-boards of the pulley, and these case-boards screwed to the strap-cases by long screws, reaching through the case-boards edgeways. Both sides of the pulley-case are fastened by one set of screws. On the outside of these blocks, round the centre of the gudgeons, are circular knobs, 6 inches diameter, and 3 inches long, strongly riveted, to keep them from splitting off, because, by these knobs the whole weight of the elevator is to hang. In the moveable frame 40, o o, o o, are these blocks with their knobs, which are let into the pieces of the frame *B C r s*. The gudgeons of the upper pulley *p* pass through these knobs and play in them. Their use is to bear the weight of the elevator that hangs by them; the gudgeons, by this means, bear only the weight of the strap and its load, as is the case with other elevators. Their being circular gives the elevator liberty to swing out from the wall to the hold of the ship.

The frame 40 is made as follows: the top piece *A B* is 9 by 8 inches, strongly tenoned into the side pieces *A D* and *B C* with double tenons, which side pieces are 8 by 6. The piece r s is put in with a tenon, 3 inches thick, which is dove-tailed, keyed, and draw-pinned, with an iron pin, so that it can easily be taken out. In each side piece *A D* and *B C* there is a row of cogs, set in a circle, that are to play in circular rabbets in the posts

* See the description of this elevator in Art. 90.

p. 41. These circles are to be described with a radius, whose length is from the centre of the joint gudgeons *G*, to the centre of the pulley 39; and the posts must be set up, so that the centre of the circle will be the centre of the gudgeon *G;* then the gears will be always right, although the elevator rises and falls to suit the ship or tide. The top of those circular rabbets ought to be so fixed, that the lower end of the elevator may hang near the wall. This may be regulated by fixing the centre of the gudgeon *G*. The length of these rabbets is regulated by the distance the vessel is to rise and fall, to allow the elevator to swing clear of the vessel when light, at high water. The best way to make the circular rabbets is, to dress two pieces of 2 inch plank for each rabbet, of the right circle, and to pin them to the posts, at such a distance, leaving the rabbet between them.

When the gate and elevator are completed, and tried together, the gate hung in its rabbets, and played up and down, then the elevator may be raised by the same power that is to raise and lower it, as described, Art. 94.

ARTICLE 96.

OF THE MEAL ELEVATOR.

Little need be said of the manner of constructing the meal elevator, after what has been said in Art. 90, except giving the dimensions. Make the pulleys $3\frac{1}{2}$ inches thick, and 18 inches diameter. Give them no more than 20 revolutions in a minute. Make the strap $3\frac{1}{2}$ inches wide, of good, pliant, white harness leather; make buckets either of wood or sheet-iron, to hold about half a pint each; put one for every foot of the strap; make the cases tight, especially round the upper pulley, slanting much at bottom, so that the meal which falls out of the buckets, may be guided into the descending case. Let it lean a little, that it may discharge the better. The spout that conveys the meal from the elevator to the hopper-boy, should not have much more than 45 degrees descent,