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 garnerers 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\(\frac{1}{3}\) 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\(\frac{1}{4}\) 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-straips 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, (4¾ 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 1½ 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 5½, and the top and bottom boards 6½ 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 AB, 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 edgeway. 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 rabbits 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 rabbits 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 rabbits is, to dress two pieces of 2 inch plank for each rabbit, of the right circle, and to pin them to the posts, at such a distance, leaving the rabbit between them.

When the gate and elevator are completed, and tried together, the gate hung in its rabbits, 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.

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**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,
that the meal may run easily down, and not cause a dust; fix it so that the meal will spread thinly over its bottom in its descent, and it will cool the better. Cover the top of the spout half-way down, and hang a thin, light cloth, at the end of this cover, to check all the dust that may rise, by the fall of the meal from the buckets. Remember to take a large cipher off the inside of the board, where it fits to the undermost side of the shaft of the upper pulley: the meal will otherwise work out along the shaft. Make all tight, as directed, and it will effectually prevent waste.

In letting meal into an elevator, it must be let in some distance above the centre of the pulley, that it may fall clear from the spout that conveys it in; otherwise, it will clog and choke. Fig. 4, Plate VI., is the double socket gudgeon of the lower pulley, to which the conveyer joins. Fig. 3, a b c d, is a top view of the case that the pulley runs in, which is constructed thus; a b is a strong plank, 14 by 3 inches, stepped in the sill, dove-tailed and keyed in the meal-beam, and is called the main bearer. In this, at the determined height, are framed the gudgeon bearers a c b d, which are planks 15 by 1½ inches, set 7½ inches apart, the pulley running between, and resting on them. The end piece c d, 7 inches wide and 2 thick, is set in the direction of the strap-case, and extends 5 inches above the top of the pulley; to this the bearers are nailed. On the top of the bearers, above the gudgeons, are set two other planks, 13 by 1½ inches, rabbetted into the main bearer, and screwed fast to the end piece c d: these are 4 inches above the pulley. The bottom piece of this case slides in between the bearers, resting on two eclees, so that it can be drawn out to empty the case, if it should ever, by any means, be overcharged with meal; this completes the case. In the gudgeon bearer, under the gudgeons, are mortises, made about 12 by 2 inches, for the meal to pass from the conveyer into the elevator; the bottom board of the conveyer trough rests on the bearer in these mortises. The strap-case, joins to the top of the pulley-case, but is not made fast, but the back board of the descending case is stepped
into the inside of the top of the end piece c d. The bottom of the ascending case is to be supported steadily to its place, and the board at the bottom must be ciphered off at the inside, with long and large ciphers, making them, at the point, only $\frac{1}{4}$ of an inch thick; this is to make the bottom of the case wide for the buckets to enter, if any of them should be a little askew; the pulley-case is wider than the strap-cases, to give room for the meal from the conveyer to fall into the buckets; and, in order to keep the passage open, there is a piece 3 inches wide, and $1\frac{3}{4}$ inches thick, put on each side of the pulley, to stand at right angles with each other, extending $3\frac{1}{4}$ inches at each end, past the pulley; these are ciphered off, so as to clear the strap, and draw the meal under the buckets: they are called bangers.

**ARTICLE 97.**

**OF THE MEAL CONVEYER.**

Fig. 3, Plate VI., is a conveyer joined to the pulley of the elevator. (See it described, Art. 88.) Fig. 4 is the gudgeon that is put through the lower pulley, to which the conveyer is joined by a socket, as represented. Fig. 5 is a view of the said socket and the band, as it appears on the end of the shaft. The tenon of the gudgeon is square, that the socket may fit it every way alike. Make the shaft $5\frac{1}{2}$ inches diameter, of eight equal sides, and put on the socket and the gudgeon; then, to lay it out for the flights, begin at the pulley, mark as near the end as possible, on the one side, and turning the shaft the way it is to work, at the distance of $1\frac{3}{4}$ inches towards the other end, set a flight on the next side, and thus go on to mark for a flight on every side, still advancing $1\frac{1}{4}$ inches to the other end, which will form the dotted spiral line, which would drive the meal the wrong way; but the flights are to be set across this spiral line, at an angle of about 30 degrees, with a line square across
the shaft; and then they will drive the meal the right way, the flights operating like ploughs.

To make the flights, take good maple, or other smooth, hard wood; saw it into 6 inch lengths, split it always from the sap to the heart; make pieces 2½ inches wide, and ¾ of an inch thick; plane them smooth on one side, and make a pattern to describe them by, and make a tenon 2½ inches long, to suit a ¾ inch auger. When they are perfectly dry, having the shaft bored, and the inclination of the flights marked by a scribe, drive them in and cut them off 2½ inches from the shaft; dress them with their foremost edge sharp, taking all off from the back side, leaving the face smooth and straight, to push forward the meal; make their ends nearly circular. If the conveyer be short, put in lifting flights, with their broad side foremost, half the number of the others, between the spires of them; they cool the meal by lifting and letting it fall over the shaft.

To make the trough for it to run in, take 3 boards, the bottom one 11, back 15, and front 13 inches. Fix the block for the gudgeon to run in at one end, and fill the corners with cleets, to make the bottom nearly circular, that but little meal may lie in it; join it neatly to the pulley-case, resting the bottom on the bottom of the hole cut for the meal to enter, and the other end on a supporter, that it can be removed and put to its place again with ease, without stopping the elevator.

A meal elevator and conveyer thus made, of good materials, will last 50 years, with very little repair, and save an immense quantity of meal from waste. The top of the trough must be left open, to let the steam of the meal out; and a door, about 4 feet long, may be made in the ascending case of the elevator, to buckle the strap, &c. The strap of the elevator turns the conveyer, so that it can be easily stopped if any thing should be caught in it; it is dangerous to turn it by cogs. This machine is often applied to cool the meal, without the hopper-boy, and to attend the bolting-hopper, by extending it to a great length, and conveying the meal immediately
into the hopper, which answers very well; but where there is room a hopper-boy is preferable.

ARTICLE 98.

OF A GRAIN CONVEYER.

This machine has been constructed in a variety of ways; the following appears to be the best; namely: First, make a round shaft, 9 inches diameter; and then, to make the spire, take strong sheet-iron, make a pattern 3 inches broad, and of the true arch of a circle; the diameter of which (being the inside of the pattern) is to be 12 inches; this will give it room to stretch along a 9 inch shaft, so as to make a rapid spiral, that will advance about 21 inches along the shaft every revolution. By this pattern cut the sheet-iron into circular pieces, and join the ends together by riveting and lapping them, so as to let the grain run freely over the joints; when they are joined together they will form several circles, one above the other, slip it on the shaft, and stretch it along as far as you can, till it comes tight to the shaft, and fasten it to its place by pins, set in the shaft at the back side of the spire, and nail it to the pins: it will now form a beautiful spiral, with returns, 21 inches apart, which distance is too great; there should, therefore, be two or three of these spirals made, and wound into each other, and all put on together, because, if one be put on first, the others cannot be got on so well afterwards; if there be three, they will then be 7 inches apart, and will convey wheat very fast. If these spirals be punched full of holes like a grater, and the trough be lined with sheet-iron, punched full of small holes, it will become an excellent rubber; will clean the wheat of the dust and down, that adhere to it, and supersede the necessity of any other rubbing machine.

The spirals may also be formed with either wooden or
iron flights, set so near to each other in the spiral lines, as to convey the wheat from one to another.

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**ARTICLE 99.**

**OF THE HOPPER-BOY.**

This machine, also, has appeared under various constructions, the best of which is represented by fig. 12, Plate VII.—(See the description Art. 88.)

To make the flight-arms C D, take a piece of dry poplar or other soft scantling 14 feet long, 8 by 2 1/2 inches in the middle, 5 by 1 1/2 inches at the end, and straight at the bottom; on this strike the middle line a b, fig. 13. Consider which way it is to revolve, and cipher off the under side of the foremost edge from the middle line, leaving the edge 3/4 of an inch thick, as appears by the shaded part. Then, to lay out the flights, take the following

**RULE.**

Set your compasses at 4 1/2 inches distance, and, beginning with one foot in the centre c, step towards the end b, observing to lessen the distance one sixteenth part of an inch every step; this will set the flights closer together at the end than at the centre. Then, to set the flights of one arm to track truly between those of the other, and to find their inclination, with one point in the centre c, sweep the dotted circles across every point in one arm; then, without altering the centre or distance, make the little dotted marks on the other arm, and between them the circles are to be swept for the flights in it. To vary their inclination regularly, from the end to the centre, strike the dotted line c d half an inch from the centre c, and 2 1/2 inches from the middle line at d, and then, with the compasses set to half an inch, set off the inclination from the dotted circles, on the line c d; the line c d then approaches the middle line, the in-
clination is greater near the centre than at the end, and varies regularly. Dove-tail the flights into the arm, observing to put the side that is to drive the meal, to the line of inclination. The bottoms of them should not extend past the middle line, the ends being all rounded and dressed off at the back side, to make the point sharp, leaving the driving side quite straight, like the flight r. (See them complete in the end c a.) The sweepers should be 5 or 6 inches long, screwed on behind the flights, at the back side of the arms, one at each end of the arm, and one at the part that passes over the hopper: their use is described in Art. 88.

The upright shaft should be 4 by 4 inches, and made round for about 4½ feet at the lower end, to pass lightly through the centre of the arm. To keep the arm steady, there is a stay-iron 15 inches high, its legs ½ inch by ½, to stride 2 feet. The ring at the top should fit the shaft neatly, and be smooth and rounded inside, that it may slide easily up and down; by this the arm hangs to the rope that passes over a pulley at the top of the shaft, 8 inches diameter, with a deep groove for the rope or cord to run in. Make the leading arm 6 by 1¼ inches in the middle, 2 by 1 inch at the end, and 8 feet long. This arm must be braced to the cog-wheel above, to keep it from splitting the shaft by an extra stress.

The weight of the balance w, must be so nearly equal to the weight of the arm, that when it is raised to the top it will descend quietly.

In the bottom of the upright shaft is the step-gudgeon (fig. 15,) which passes through the square plate 4 by 4 inches (fig. 14;) on this plate the arm rests, before the flights touch the floor. The ring on the lower end of the shaft is less than the shaft, that it may pass through the arm: this gudgeon comes out every time the shaft is taken out of the arm.

If the machine is to attend but one bolting-hopper, it need not be above 12 or 13 feet long. Set the upright shaft close to the hopper, and the flights all gather as the end c b, fig. 13. But, if it is to attend for the grinding of two pair of stones, and two hoppers, make it 15
feet long, and set it between them a little to one side of both, so that the two ends may not both be over the hoppers at the same time, which would make it run uneasily; then the flights between the hoppers and the centre must drive the meal outwards to the sweepers, at the end c a, fig. 13.

If it be to attend two hoppers, and cannot be set between them for want of room, then set the shaft near to one of them; make the flights so that they all gather to the centre, and put sweepers over the outer hopper, which will be first supplied, and the surplus carried to the other. The machine will regulate itself to attend both, although one should feed three times as fast as the other.

If it be to attend three hoppers, set the shaft near the middle one, and put sweepers to fill the other two; the surplus will come to the centre one, and it will regulate to feed all three; but should the centre hopper ever stand while the others are going, (of either of these last applications,) the flights next the centre must be moveable, that they may be turned, and set to drive the meal out from the centre. Hopper-boys should be driven by a strap in some part of their movement, that they may easily stop if any thing catch in them; but many millwrights prefer cogs: they should not revolve more than 4 times in a minute.

ARTICLE 100.

OF THE DRILL.

(See the description, Art. 88.) The pulleys should not be less than 10 inches diameter for meal, and for wheat, more. The case they run in is a deep, narrow trough, say 16 inches deep, and 4 wide, pulleys and strap 3 inches. The rakes are little, square blocks of willow or poplar, or any soft wood, they will not split by driving the nails; they should all be of one size, that each may
take an equal quantity; they are nailed to the strap with long, small nails, with broad heads, which are inside the strap; the meal should always be let into them above the centre of the pulley, or at the top of it, to prevent its choking, which it is apt to do, if let in low. The motion should be slow for meal, but may be more lively for wheat.

*Directions for using a Hopper-boy.*

1. When the meal elevator is set in motion to elevate the meal, the hopper-boy must be set in motion also, to spread and cool it; and as soon as the circle is full, the bolts may be started; the grinding and bolting may likewise be carried on regularly together; which is the best way of working.

2. But if you do not choose to bolt as you grind, turn up the feeding sweepers and let the hopper-boy spread and cool the meal, and rise over it; and when you begin to bolt, turn them down again.

3. If you choose to keep the warm meal separate from the cool, shovel about 18 inches of the outside of the circle, in towards the centre, and turn the end flights, to drive the meal outwards; it will then spread the warm meal outwards, and gather the cool meal into the bolting hopper. As soon as the ring is full with warm meal, rake it out of the reach of the hopper-boy, and let it fill again.

4. To mix tail-flour or bran, &c., with a quantity of meal that is under the hopper-boy, make a hole for it in the meal quite to the floor, and put it in; and the hopper-boy will mix it regularly with the whole.

5. If it do not keep the hopper full, turn the feeding sweeper a little lower, and throw a little meal on the top of the arm, to make it sink deeper into the meal. If the spreading sweepers discharge their loads too soon, and do not trail the meal all around the circle, turn them a little lower; if they do not discharge, but keep too full, raise them a little.
ARTICLE 101.

OF THE UTILITY OF THESE INVENTIONS AND IMPROVEMENTS.

In order to dry the meal in the most rapid and effectual manner, it is evident, that it should be spread as thinly as possible, and be kept in motion from the moment it leaves the stones, until it be cold, that it may have a fair opportunity of discharging its moisture, which will be done more effectually at that time, than after it has grown cold in a heap, and has retained its moisture; this immediate drying does not allow time for insects to deposite their eggs, which, in time, breed the worms that are often found in the heart of barrels of flour well packed; and, by the moisture being expelled more effectually, it will not be so apt to sour. The first great advantage, therefore, is, that the meal is better prepared for bolting, for packing, and for keeping, in much less time than usual.

2. They do the work to much greater perfection, by cleaning the grain and screenings more effectually, hoisting and bolting over great part of the flour, and grinding and bolting over the middlings, all at one operation, mixing those parts that are to be mixed, and separating such as are to be separated.

3. They save much meal from being wasted, if they be well constructed, because there is no necessity for trampling in it, which trails it wherever we walk, nor shoveling it about to raise a dust that flies away, &c. This article of saving will soon pay the cost of making the machinery, and of keeping it in repair afterwards.

4. They afford more room than they take up, because the whole of the meal loft that heretofore was little enough to cool the meal on, may be spared for other uses, excepting the circle described by the hopper-boy; and the wheat garners may be filled from one story to another, up to the crane-spout, above the collar-beams; so that a small part of the house will hold an unusual
quantity of wheat, and it may be drawn from the bottom into the elevator, as wanted.

5. They tend to despatch business, by finishing as they go; so that there is not as much time expended in grinding over middlings, which will not employ the power of the mill, nor in cleaning and grinding the screenings, they being cleaned every few days, and mixed with the wheat; and as the labour is easier, the miller can keep the stones in better order, and more regularly and steadily at work, especially in the night time, when they frequently stop for want of help; whereas, one man would be sufficient to attend six pair of stones, running (in one house) with well constructed machinery.

6. They last a long time, with but little expense of repair, because their motions are slow and easy.

7. They hoist the grain and meal with less power, and disturb the motion of the mill much less than the old way, because the descending strap balances the ascending one, so that there is no more power used, than to hoist the grain or meal itself; whereas, in the old way, for every 3 bushels of wheat, which fill a 4 bushel tub with meal, the tub has to be hoisted, the weight of which is equal to a bushel of wheat; consequently, the power used is as 3 for the elevator to 4 for the tubs, which is one-fourth less with elevators than tubs; besides, the weight of 4 bushels of wheat, thrown at once on the wheel, always checks the motion; before the tub is up, the stone sinks a little, and the mill is put out of tune every tub-full, which makes a great difference in a year's grinding; this is worthy of notice when water is scarce.

8. They save a great expense of attendance. One-half of the hands that were formerly required are now sufficient, and their labour is easier. Formerly, one hand was required for every 10 barrels of flour that the mill made daily; now, one for every 20 barrels is sufficient. A mill that made 40 barrels a day, required four men and a boy; two men are now sufficient.