MILLSTONES

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Many millstones in use are not suitable for the present system. There are also a great many millstones hung in such a way that they are incapable of high class work and, nevertheless, all these have been doing the work of the country, proving that with superior workmanship and greater care in details they are capable of doing far superior work. I meet some men who do not believe in these niceties, others do not understand them, and many do not realise their importance, so I have endeavoured to treat each item so that any ordinary workman can understand it, risking repetition of some facts that are not new; and I have rather tried to include all that bears on the subject in a consecutive form, and so avoid the necessity of repeating explanation every time the subject is brought forward. In the natural course of events, some other way than that of running the upper stone may come into use. Some persons advise running the lower stone. The want of practical belief in the necessity of carrying out the details has in many cases allowed the roller millers to gain advantage.

Facing

The face of a millstone should be a "plane" or level surface.

(I leave the "dress" and "swallow" for another opportunity.) Mr Babbage, writing some fifty years ago, says: "if two surfaces are working against each other, whatever may have been their figure at commencement, there exists a tendency in them both to become portions of spheres. Either of them may become convex and the other concave, with various degrees of curvature. A plane surface is the line of separation between convexity and concavity, and is most difficult to hit; it is easier to make a good circle than a straight line."

The plane may be obtained with machinery, as in turning and planing. In obtaining it by hand with ordinary "stone-staff," however much or little of the surface has to be taken off, I think it is easiest to mark out beds or spaces across the face, just wide enough to allow free working of the stone-staff. Some men say they can do without, but I have never known them to do so, or certainly not without wasting their labour.

The number of beds I prefer for many good reasons is three, Figure 1, supplemented by three others as in Figure 1a.

Figure 1

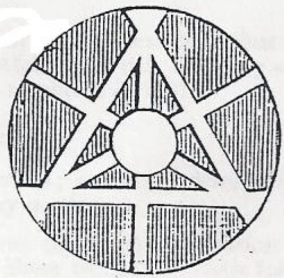
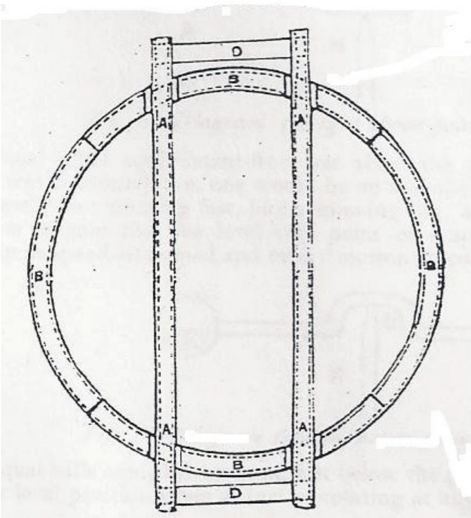


Figure 1a

These beds indicate definitely where the plane or face will be and are themselves part of the finished face. Each bed must be made true from end to end before beginning the next, and each bed must "staff" on all beds that it crosses. My workmen have to follow this plan, and they all prefer it to any other when they once understand it.

In turning and planing, accuracy depends on the machine. Machines standing on the face of the millstone naturally follow the inaccuracies of the surface on which they rest and give bad results. The idea of the lathe may be obtained for hand work by using a trammel to staff a ring or circular bed on the face of the stone, and the idea of a planing machine is obtained with the straight beds, the intervening surface in both cases being levelled with the aid of the staff and mill-bill (for I do not intend to consider the relative advantage of the "diamond" "corrundum" or other means).

A circular staff indicates at once the high place, as it cannot mark the low parts, and is certainly almost indispensable to a miller who wishes to keep his stones in floor or out of winding. It can only take a bearing on the part that wants taking down, so that it requires less skilful handling than a straight staff. A miller seeing it used for the first time would be surprised to find how few of the stones in the mill are true enough to stand the test. The late Mr. Potto Brown, of whom I cannot speak too highly, took great pains with his millstones, and I find on June 23, 1868, a patent in the name of Potto and Bateman Brown for a circular stone staff, but it is now public property as the patent was not carried through.



The following is a sketch of the staff shewn at the meeting:

A,A,A,A. - Two parallel straight edges of mahogany
B,B,B,B. - Circular staff, built in segments and layers of mahogany
D,D - Cross bar handley by which the staff may be held when in use

Potto & Bateman Brown's Patent Millstone Staff

I read the following from the specification: "In place of forming the staff as a single straight-edge, so that it gauges the stone only in one straight line across it, we so form the staff as to gauge the stone simultaneously in several lines at the same time, and so arranged that should the stone be low on any side the staff may be sure to take a bearing on the high side only, and be prevented falling into the hollows to colour them. We prefer to construct the staff of two parallel straight edges connected together to a circle some-what smaller in diameter than the stone. When the instrument is in use colour is applied to the straight edge, or it may be to the whole of the face, and the instrument is applied to the stone with one of its straight-edges on either side of the centre or eye. These edges (if they alone be coloured, as we prefer) communicate the colour to the high parts on which they chance to bear; but should it so happen that the highest parts are not beneath the edges, then the ring sustains them out of contact with the face of the stone. The form of the instrument may be to some extent varied, but it will be observed that whereas the staff heretofore employed is a straight-edge, taking its bearing along one side only, our improved staff is in principle an extended skeleton surface, which, however it may be applied, takes its bearing on the high parts of the stone only. This skeleton surface or frame is very portable and convenient in use; it is true without difficulty, and is easily coated with colour, advantages which a complete surface would not have, and the absence of which renders a complete surface inapplicable."

Levelling Bedstone and Adjusting Spindle

The face of both runner and bedstone being perfect planes, the "stone spindle" has to be set vertical or perfectly upright, and one of the easiest ways to accomplish this is to use a "jackstick with level" fix it firmly with the screws A B C D on the stone spindle just below the cockhead or "cockade" adjust the level by the set screw F, and the stone spindle must be vertical when the bubble E, retains the same position in the tube in whatever direction the jackstick is turned.

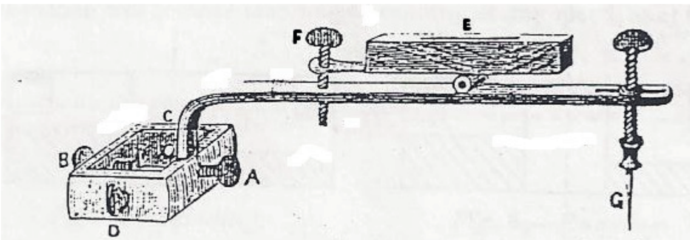


Figure 2 Jack-Stick with Spirit Level

To Level the Bedstone

Without shifting the jackstick, fix a quill, G, in the end, and adjust the bedstone so that the quill just touches the face all round, and the bedstone will be perfectly horizontal. See that the step and neck fit properly and are held firmly. Also take the precaution before taking the jackstick off to see that it has not got loose on the spindle, turn it carefully round and see that the bubble still retains its stationary position, while the quill just touches the face of the bedstone over which it passes.

Hanging and Balancing Runner

The "centre bar" should be fixed as nearly centrally as possible (by measuring from the circumference of the stone), or when suspended on the spindle the stone will be heavier on one side than another.

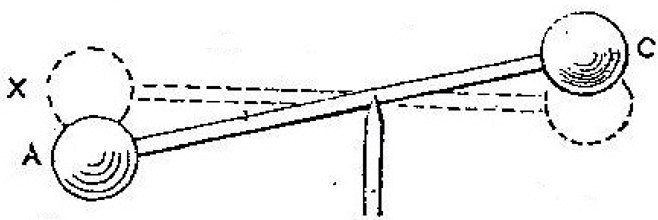


Figure 3 Diagram of Pivot out of centre

The balls, A C, being of same weight, A will hang lower than C.

The stone should be suspended at a point somewhat above its centre of gravity, as it is easily balanced by adding weight to the back of the stone, but if the centre bar is fixed so that the point of suspension is below the centre of gravity, the weights for balancing need to be heavier, and below the face (where there is no place for them), and the stone cannot be balanced.

An ordinary scale beam (one, for instance, about 4 ft. long, such as is generally used for weighing sacks of flour) has its knife edge at the (pivot) fulcrum, P, about 1-16th of an inch above the line of the "knife edges" S, S (on which the scales hang); if they were on the same level the beam would oscillate too much and make the operation of weighing too slow and tedious for commercial purposes, and if the fulcrum, P, were below the line, S, S, the beam would not oscillate, for either and would remain down without recovering itself.

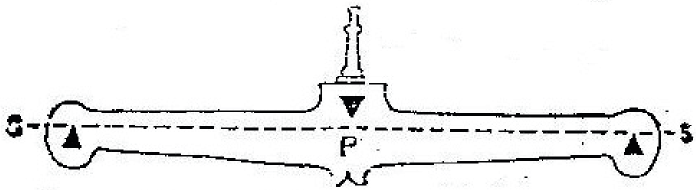


Figure 4 Ordinary Scale Beam

The stone should oscillate freely on the cockade.

Boxes are provided in the back of the runner for holding lead to adjust the balance of the stone, so that the face is horizontal while it is standing still, but it is also necessary and even more important to obtain *as well* a

Running Balance

Standing balance is an adjustment for gravitation; running balance is an adjustment for centrifugal action, caused by rotary motion.

Bodies fall by gravitation; bodies fly off from the centre of motion by centrifugal force, and it is only by adjustment of these two antagonistic forces that the face of a millstone can be maintained in a true horizontal position while running.

It is well known that a ball attached to a string when swung round will rise till the string is nearly level. When an ordinary governor revolves, the balls endeavour to fly from the spindle, but the arms being hinged above, the balls must rise to get away, and the greatest distance they can attain is when they are out straight, in a line level with the point of attachment. The greater the speed, the nearer they approach

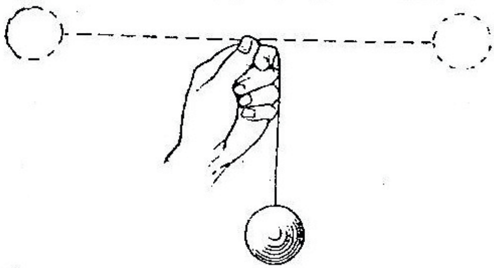


Figure 5
Diagram Illustrating
Centrifugal action

this line, and no speed will cause them to rise above it. A millstone that is well and evenly built and balanced for gravitation (standing balance) will run better for the care that has been expended on it, but that is not sufficient to secure a running balance, for it is practically impossible to make a millstone of perfectly even density or weight.

When rotated, the ball A will rise and C fall, and at a high speed might be on a level with the point of suspension and return to the old position as the speed slackened. The same would be the case with balls of unequal weight at equal distance from point of suspension.

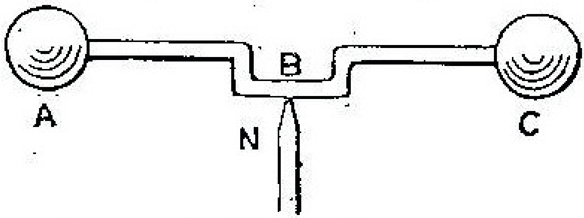


Figure 6 Diagram (weight above point of suspension)

Equal balls, equi-distant from but above the point of suspension, when at rest would overbalance, one would be up and the other down, but both would be level when rotated fast, like a spinning top, as the balls would exert equal power to gain the line level with point of suspension, and wobble and fall again as speed slackened and rotary motion stops.

Equal balls equi-distant from, but below the point of suspension, will retain their level position when at rest or rotating at any speed.

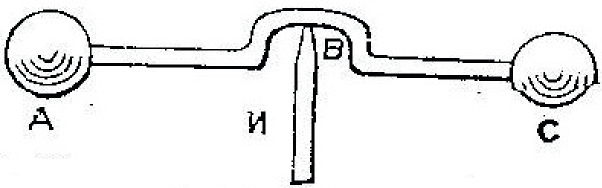


Figure 7 Diagram (weight below point of suspension)

A millstone is built of separate burrs of different densities, and the backing consists of stone chips and cement which is not so heavy as burr.

The heavy or denser burr will fall when standing still, Figure 8, but when running will exert greater force than the light burr towards the point of suspension and cause the light burr to dip, as at Figure 8_1.

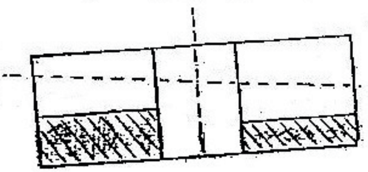


Figure 8 Standing

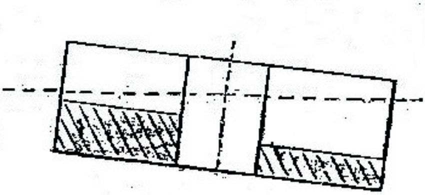


Figure 8_1 Running

Weights may be put in the bottom of the balance boxes that will balance the stone standing, Figure 8_2, and yet the light burr will dip when running, as at Figure 8_3.

The same weights may be so raised that they will exert a force downwards to the line of suspension to compensate the force of the large burr upwards, so that the stone will balance standing or running at any speed, as at Figure 8_4 and 8_5.

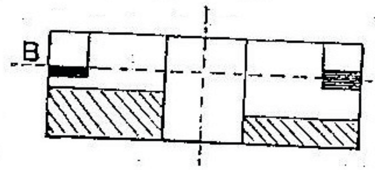


Figure 8_2 Standing

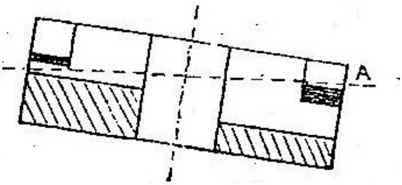


Figure 8_3 Running

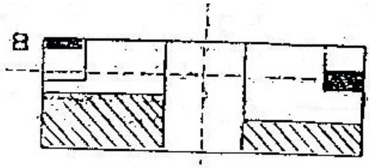


Figure 8_4 Standing

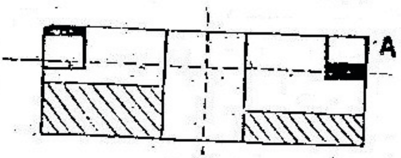


Figure 8_5 Running

Hence it follows that a stone may balance while standing still, and yet not balance while running, and in the same way a stone may balance while running at a certain speed, and not balance when standing still.

Clarke and Dunham's Patent Balance Boxes have iron weights in each, and these iron weights are filled in when necessary with lead, until the standing balance is obtained. The lids of the four boxes are then fixed on, and the weights, which are suspended by a screw, are raised or lowered with a key or socket spanner to adjust for the running balance.

The runner must be raised so as not to touch the bedstone, and made to revolve in the ordinary way.

A quill, or thin flat splinter of wood, dipped in reddle, inserted between the stones, and the point gradually brought in contact with the face of the runner will mark the face of the stone where it dips, or with care and a little practice, the back of the stone may be marked with a feather, or the fingers dipped in reddle, on the part corresponding with the part of the face that dips and causes a hissing noise when it touches the quill. The stone must be stopped, and the weights lowered in the box A, where the back of the stone is marked or raised in the opposite box B, by turning the screw with the key to lower or raise the weights. The stone must be again revolved, the side that dips agained marked, and this operation repeated until the face of the runner runs so true that no wobble can be appreciated.

The weights cannot shift, and the same balance is maintained in good order, and only requires altering with the ordinary wear and tear of the stones.

Mace and Centre Bar

The mace should grip the centre bar evenly, both back and front, for should the mace M, touch the centre I, at the top and not at the bottom (be the difference ever so little) it is apt to cant the face of the stone from A to X. Pieces of thin paper in the jaws of the mace will be nipped where the pressure comes when the stone is revolved, and the mace or centre bar can be filed or fitted accordingly. The driving power applied to the centre bar, above the point of suspension, allows the stone to hang more freely than when gripped below the point of suspension near the face.

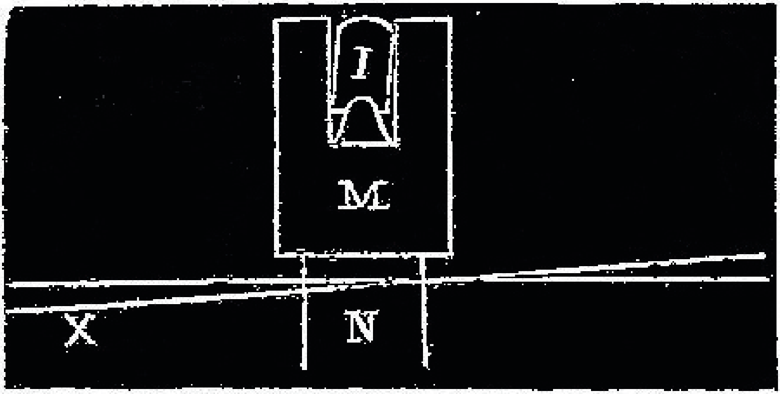


Figure 9 Mace and Centre Bar

Pivot or "Cockhead"

A sharp point (1, Figure 10) is the most sensitive, but with a heavy weight like a millstone, and which has continually to be taken up and put down again it is apt to wear or get knocked about, which alters the level of the point of suspension and destroys the balance.

If the point is made rounded (2., Figure 10) it is subject to the same objection, or if it is flat on the top, the centre bar is apt

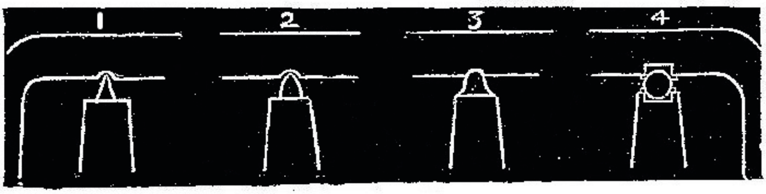


Figure 10 Pivot or "Cockhead"

to ride, so that half the circular top (3, Figure 10) or a perfect globe (4, Figure 10) being more likely to be made true appears the best, as the level of the point of suspension is the centre of the sphere which is the least likely to be altered or affected by any amount of oscillation or wear.

Patent Driving Irons

There are many patent driving irons, and some from America are guaranteed to produce a standing and running balance. I have examined a few, but I fail to understand how it is accomplished. By investigating the shape of the pivots, levels of the centres of oscillation, fit of the bearings, and position where the power is applied, the weak points may be easily detected, and it should be borne in mind that increased number of bearings means increased chance of inaccuracy.

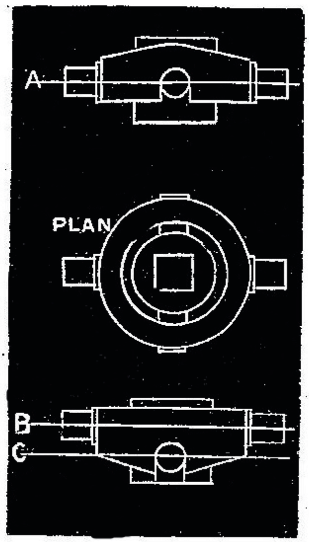


Figure 11

Universal Driving Irons

Universal Driving Irons

Require to be carefully made, for if the four trunnions are not easily on the same level, A, it is evident there are two points of suspension or centres of oscillation on two different levels, B, C, and it is very difficult even if it is possible to balance a millstone so hung.

These sorts of driving irons also generally so near the face of the stone or below the centre of gravity that the stone must wobble or one side drag round on the bedstone until it runs at a considerable speed.

Speed

In England, 110 to 140 revolutions per minute is a fair average for a four-foot stone. In France, I find it about the same, viz. 490 meters on the circumference.

The dress of the stone must to a great extent be regulated by the speed, quality of stone, and work desired to be done. The dress that is suitable for 110 revolutions is not likely to suit the quality of material that would pass through the stones running at 160 revolutions per minute, whether with low, half round, or high grinding.

Results of Defects

If the stone is not pivoted in the centre, although it may be balanced so that the face runs in a true horizontal position, or if the stone is not properly balanced, there will be a side strain, causing wear on the side of the neck and toe of spindle, and undue wear of the neck and step brasses. If the stone wobbles, or one side drags on the bedstone, the stones wear unevenly, and are apt to strike fire, unless there is sufficient meal between them to protect the surfaces, like a fender between a steamboat and a landing stage, and some of the flour will be killed and the rest not properly ground, and the meal will be treated as though the faces were not true, causing vibration, waste of power, wear and tear or expenses for repairs, production of less flour, and of an uneven and much lower quality than the wheat is capable of yielding, and requiring finer silks and more dressing and purifying machinery than is necessary; the bran cannot be clean, and some is so finely powdered as to be very difficult of separation.

Stiff Driving Irons

Keep the stone rigid in the position in which it is set, but it requires care to adjust it each time it is put down. If set exactly horizontal, one side cannot drag on the bedstone, but unless properly balanced, it will exert its power to take its own course, which would be a wobble, causing undue wear of bearings, etc., and it cannot well relieve itself should any foreign substance enter with the wheat without lifting the spindle, or the stone if it is loose.

I have heard it stated that a runner hung in the ordinary way is floating, or its weight practically diminished by about 1 cwt. For each bushel of grain ground per hour.

Mr. J. H. Carter, in his paper read before this Association in January last, in speaking of an experiment with stiff irons, says, "We anticipate at least an increase of 10 per cent. of middlings over balanced stones. The result was nil, and we attribute it to so much weight of the stone being carried by the wheat that the runner, as it were, became unsteady on the irons. It is also more troublesome to keep in order than the balanced stones. In shelling oats and ending wheat, from which the idea originated, the operation is a light one, no appreciable pressure of the stone being required."

Under Stone Running

Requires very careful balancing, and if fixed rigidly to the spindle it works like on stiff irons. Unless the upper stone is simply held in position by its own weight there is no relief in the event of any foreign substance entering. The advantages are that the feed drops on a live instead of a dead surface, is at once distributed, cannot collect on any part of the face, and is perhaps capable of doing more work than with the upper stone running. With mills of small size any degree of pressure can be exerted, and a large feed can be passed through, which would lift the upper stone off its bearings were it to depend upon its weight only.

There are also advantages for certain classes of work. For instance, in splitting beans the object is to open, but not in any way to grind them (or a greater quantity is required to fill the bushel), and the live understone drives them out as soon as their size is reduced so that they cannot be nipped between the two faces again.

Both Stones Running

If stones run in reverse directions, the speed of each need be only (60) half that of one stone running (120), or they can go respectively at different speeds (as 40 and 80) to make the faces pass each other at the same rate; but I know of no advantage of this arrangement to compensate for the trouble of running both stones. If both stones run one way, the practical speed of the faces is only the difference of the speed of one beyond of the other, causing loss of power without corresponding advantage.

Vertical Mills

Millstones working in a vertical position would not, I should think, distribute the feed equally over the surface. One runner with two faces can do double work between two bed or fixed stones, but the two faces of the runner must be exactly parallel.

Conclusion

A master miller, who personally tests periodically with a circular staff, jack-stick, and quill, that the stones are true and in running balance, need fear no competition in manufacturing, and a journeyman who can accomplish it need never want a berth.

An upper runner is the easiest to take up and put down, is easy to drive, is the best understood, and least liable to accident; and I believe that an upper stone free to oscillate, with an inclination, or rather a powerful determination to retain its perfect horizontal position against all obstacles while running at any speed, is not to be equalled.

The introduction of the purifier for middlings has so altered the work required of a millstone, from grinding to granulating, that I believe very few millers know to what extent the millstone is capable of doing the work for the present system of milling.