

DESCRIPTION OF OATES' BRICK-MAKING MACHINE.

BY MR. JOHN E. CLIFT, OF BIRMINGHAM.

In ordinary hand-made bricks, the main expense of the process of making, besides the burning, consists in the preparation of the clay, so as to render it sufficiently ductile to allow of its being forced into the moulds by hand-pressure; this necessitates the mixture of water with it, and thus requires also the further process of drying the bricks before placing them in the kiln. The risk of damage and the delay from weather also add materially to the expense of hand-made bricks. The application of machinery to the manufacture of bricks has for its objects economy, certainty, and expedition of production, and improvement in the quality and appearance of the bricks. It is still a question how far these objects have been attained; and out of the large number of machines invented for brick-making but few are at present in regular work: omitting tile and pipe-making machines. The machines now at work may be divided into two classes:—those which operate upon the clay in a moist and plastic state; and those for which the material requires to be dried and ground previous to being moulded. In the former class, the plastic column of clay, having been formed in a continuous length by the operation of a screw, pugging blades, or rollers, is divided into bricks by means of wires moved across, either whilst the clay is at rest, or whilst in motion by the wires being moved obliquely at an angle to compensate for the speed at which the clay travels. In consequence of the clay having to be made sufficiently soft to allow of this wire-cutting, the bricks made are but little harder than those made by hand, and require similar drying before being placed in the kiln; and this drying, together with the expense of preparing the clay in the requisite manner, renders the expenses of manufacture

similar to those involved in hand-made bricks. In the second class of machines, a superior finish of appearance is obtained in the bricks by their compression in a dry state in the mould; and the objection of subsequent drying is avoided: but the additional preparation requisite in drying the clay and reducing it to a sufficiently fine and uniformly pulverised state, and the more expensive character of the machinery involved, add materially to the cost of manufacture.

By means of the brick-making machine described in the present paper, which is the invention of Mr. Oates of Erdington near Birmingham, the difficulty of previous preparation of the clay required in the second class of machines is not incurred; while at the same time the subsequent drying of the bricks required with the other machines is avoided. In this machine the clay is used of such a degree of dryness as to allow of its being mixed up and macerated and compressed into bricks by a single continuous action; the clay being formed into a continuous column and compressed into the moulds by the action of a revolving vertical screw. The clay requires generally no previous preparation beyond that given by the ordinary crushing rollers, and is sometimes ready for putting into the machine direct from the pit; in other cases, where containing a mixture of stones, it is first passed through a pair of crushing rollers.

The machine is shown in Plates 48 to 51. Fig. 1, Plate 48, is an end elevation of the machine; Fig. 2, Plate 49, is a front elevation, and Fig. 3 a plan; Fig. 4, Plate 50, is a vertical transverse section enlarged, and Fig. 5 a plan of the screw; and Fig. 6, Plate 51, is a longitudinal section of the machine.

The cast iron clay cylinder A, Fig. 4, Plate 50, is expanded at the upper part to form a hopper into which the clay is supplied, and the lower cylindrical portion is about the same in diameter as the length of the brick mould F at the bottom of the pressing chamber B. The vertical screw C is placed in the axis of the clay cylinder, and carried by two bearings in the upper frame D: this screw is parallel at the lower part, the blade nearly filling the parallel portion of the clay cylinder, and is tapered conically at the upper part to nearly double the diameter. When the clay is thrown loosely into the

hopper, it is divided and directed towards the centre by the curved arm E revolving with the screw shaft, and drawn down by the tapered portion of the screw into the parallel part of the clay cylinder, in sufficient quantity to keep this part of the cylinder constantly charged, any surplus clay easily escaping laterally into the loose clay in the hopper. The clay is then forced downwards by the parallel portion of the screw into the pressing chamber B, and into the brick mould F, which consists of a parallel block equal in thickness to a brick and sliding between fixed plates above and below, and containing two moulds F and G, Fig. 6, Plate 51, corresponding in length and breadth to the bricks to be made.

The mould block F, Fig. 6, Plate 51, is made to slide with a reciprocating motion by means of the revolving cam H, which acts upon two rollers in the frame I connected to the mould block by a rod sliding through fixed eyes; and the two brick moulds are thus placed alternately under the opening of the pressing chamber B to receive a charge of clay, the mould block remaining stationary in each position during one quarter of a revolution of the cam H. When the brick mould F is withdrawn from under the press chamber, the brick is discharged from the mould by the descent of the piston K, which is of the same dimensions as the brick mould; the piston is pressed down by the lever M worked by the cam N, when the brick mould stops at the end of its stroke, and is drawn up again before the return motion of the mould begins. A second piston L acts in the same manner upon the second brick mould G; and the discharged bricks are received upon endless bands O, Figs. 1, 2, and 3, Plates 48 and 49, by which they are brought successively to the front of the machine, where they are removed by boys to the barrows for conveying them to the kiln to be burned.

The solid block that divides the two brick moulds F and G is slightly wider than the discharge opening at the bottom of the pressing chamber B, having an overlap so that the making of one brick is terminated before that of the next begins, in order to ensure completeness in the moulding. During the instant when this blank is passing the opening at the bottom of the pressing chamber, the

discharge of the clay is stopped, and it becomes necessary to provide some means of either relieving the pressure during that period or stopping the motion of the pressing screw. The latter plan would be impracticable; and in this machine the former mode is provided by a very ingenious contrivance, forming in effect a safety valve, which prevents the pressure in the chamber from increasing when the brick mould is shut off, and also serves to maintain a uniform pressure during the formation of the brick, so as to ensure each mould being thoroughly and equally filled with clay. This is effected by an escape pipe P, Fig. 4, Plate 50, which is similar in form to the brick mould, but extends horizontally from the side of the pressing chamber, and is open at the outer extremity. The regular action of the screw forces the clay into this escape pipe as far as its outer extremity, forming a parallel bar of clay in the pipe: the resistance caused by the friction of this bar in sliding through the pipe is then the measure of the amount of pressure in the machine; and this pressure cannot be exceeded in the machine, for the instant that the brick mould is full the further supply of clay fed into the pressing chamber by the continuous motion of the screw escapes laterally by pushing outwards the column of clay in the escape pipe. The uniform pressure of every brick in the mould up to this fixed limit is ensured by the escape pipe not beginning to act until that limit of pressure is reached. Its action is similar to that of a safety valve; and the amount of pressure under which the bricks are made is directly regulated by adjusting the length of the escape pipe.

The important result of this arrangement is that it prevents any risk of overstraining the machine; and the action of the screw has a special advantage in filling the brick mould with a continuous uniform stream of clay, which is being constantly supplied at a uniform moderate pressure, so as to ensure the mould being thoroughly filled with a uniform density of clay throughout, without requiring any sudden excessive pressure that would cause the brick to be denser on the outside than in the centre. The pressing chamber is made larger in transverse area than the supplying screw cylinder, in order to increase the uniformity of pressure on the clay in the chamber; and the regularity of action is shown by the working of the escape pipe,

which discharges a continuous bar of solid clay, advancing by intermittent steps of $\frac{1}{4}$ to $\frac{1}{2}$ inch length each time that the brick mould is shut off and changed. The projecting piece of clay from the end of the escape pipe is broken off from time to time and thrown back into the hopper of the machine.

The upper side of the solid block separating the two moulds F and G is faced with steel, as shown in Figs. 4 and 6, Plates 50 and 51, and the upper face of the brick is smoothed by being sheared off by the edge of the opening in the pressing chamber; the under face of the brick is smoothed by being planed by a steel bar R, Fig. 6, fixed along the edge of the under plate, having a groove in it for discharging the shaving of clay taken off the brick.

The screw shaft is driven by bevil gear from the shaft S, Fig. 1, Plate 48, which is driven by a strap from the engine, the speed being adjusted according to the quality of the clay or the wear of the screw. The screw is driven at about 30 revolutions per minute, delivering the bricks at the rate of about 30 per minute when at full speed, or one brick for each revolution of the screw. The machine completes regularly in ordinary work 12,000 bricks per day, or an average of 20 good bricks per minute. The amount of power required for driving the machine and the wear of the screw vary according to the material worked. At the Oldbury Brick Works, where two of the machines have been working regularly for three years, the clay is a calcareous marl, and the power required for each machine is about 12 horse power; the rate of manufacture is 20 bricks per minute.

The wear of the screw varies considerably according to the material of which it is made and the quality of the clay worked in the machine. In a machine working at Cobham cast iron screws have been worn out in a short time with very silicious material; but in two machines working at Gosport for two years, the screws have been renewed only once in that time, although as much as 3 million bricks were made by the machines. In another machine working for two years at the Blaenavon Iron Works, the screw and mould block have been made of gun metal, and are found considerably more durable.

With regard to the burning of the bricks made by these machines, no difficulty has been found from the bricks not having been dried before stacking in the kiln ; and a very small proportion of waste is made in the burning. Where the clay contains much alumina and retains more moisture in consequence, it is found advisable to stack the bricks in the kiln in "lifts" as they are termed, of from 15 to 20 courses each ; as soon as the bottom lift has been stacked, small fires are lighted to drive off the steam from the bricks which might otherwise soften those stacked above ; the middle lift is then stacked and similarly dried, and then the top lift, after which the full fires are lighted. In other cases the whole kiln is stacked at once, and no difficulty is experienced from the lower bricks not being able to bear the weight of the rest.

The quality of the bricks is shown by the specimens exhibited from machines working in different places ; and they have been found thoroughly satisfactory in soundness and strength. The crushing strength of these bricks made in the machines at Oldbury has been found to be double that of the hand-made blue bricks of the neighbourhood, being an average of 150 tons as compared with 76 tons, or 8024 lbs. per square inch compared with 4203 lbs. The transverse strength with 7 inches length between the bearings is

Hand-made bricks	2260 and 2440, average 2350 lbs.	Excess over hand-made.
Machine-made bricks...	2960 and 3210, ,, 3085 ,,	31 per cent.
Do. hard burned	3960 and 4680, ,, 4320 ,,	84 per cent.

With regard to the economy of manufacture by the machine, the two expensive processes of drying the bricks before burning as in hand-making and wet machine-making, or of preparing and pulverising the clay as in dry-clay machines, are dispensed with entirely or to a great extent ; and the power required for working and the cost of repairs are much reduced as compared with other machines by the simplicity of construction : the mode of applying the power by the action of the screw with the provision of the escape pipe effectually prevents any undue strain upon the machine, and avoids the sources of wear arising from very heavy pressure or the concussion of blows. The economy and advantages resulting from the application of machinery to the manufacture of bricks are so important that

when once the practical difficulties are thoroughly surmounted it must be expected to have a rapid extension; and instead of so small a proportion being manufactured by machinery out of nearly 2000 millions of bricks made annually in this country, the time cannot be far distant when hand-made bricks will become nearly as rare as flail-thrashed corn.

Mr. CLIFT said he had seen the working of the machines at Oldbury on several occasions, and they worked exceedingly well, producing bricks of a uniform good quality with great rapidity. In some others of the machines it had been stated that as many as 30 bricks per minute had been made, and even 20,000 bricks per day had been produced by one machine when working under very favourable circumstances; but in the machines that he had seen the regular run of work that was produced with certainty was 20 good bricks per minute exclusive of wasters, or 12,000 per day of 10 hours, with a 12 horse power engine; and the machine could be relied on to continue turning out this quantity of bricks throughout the entire year. He exhibited a number of samples of the bricks made by the machine, which he considered were fair specimens of the ordinary quality produced and fit for any kind of work; and showed also specimens made from different qualities of clay in different parts of the country.

Mr. H. G. LONGRIDGE thought the machine described in the paper was decidedly the most perfect brick-making machine he had yet seen: he had seen it at work at Oldbury and at Stourbridge, and the bricks produced appeared to be of very good quality. At Oldbury there was a great quantity of stone in the clay, forming a material which it would be almost impossible to work for hand-made bricks; and he was surprised at the excellence of the bricks that he saw turned out by the machine with that clay. The machine seemed well contrived for durability, and would be subjected to but a small amount of wear, the greater part of the wear and tear being on the screw; the amount of this wear was perhaps rather understated in the paper, as a

considerable amount of wear must generally be expected. As soon as the screw had become much worn a waste of power would occur, from the clay slipping back past the screw, and being merely kneaded up without being pressed into the mould; and there must always be a spare screw at hand to replace that in the machine as soon as worn out. In reference to the quantity of bricks produced by the machine, he saw them turned out as fast as the boys could pick them off from the front of the machine.

Mr. E. A. COWPER remarked that the bricks exhibited had not any hollow or frog in the upper face; and enquired whether that could be done by the machine, as it was generally considered an advantage for holding the mortar.

Mr. OATES said this had not yet been done, but an arrangement was now being made to accomplish it with the machine. Some of the bricks exhibited having a stamp on one of the faces had been pressed in a separate pressing machine immediately on leaving the moulding machine, and some model bricks were shown on which the stamp had been put in the moulding machine by an improvement in the apparatus.

Mr. J. MANNING thought the machine that had been described was well worth the attention of practical men: he had seen three of the machines at work at Oldbury and Stourbridge, and was satisfied of their practical efficiency; in each case excellent bricks were turned out. The rate of production he observed to be frequently 30 bricks per minute, with some few wasters amongst this number; and he was sure therefore that 20 good bricks per minute was safely within the limit. An important object to be aimed at in the construction of brick-making machines was to reduce the number of processes through which the clay had to pass in being formed into bricks, in order to simplify the application of machinery and effect economy in cost and time of manufacture: this object he thought was well carried out in the machine now described, for the clay was taken direct from the pit, passed through the crushing rollers, and then fed straight into the moulding machine; and in a quarter of an hour after being brought from the pit he had seen the same clay in bricks stacked in the kiln; and in a few days they were burned ready for use.

Mr. SAMPSON LLOYD observed that defects had been found in previous brick-making machines, particularly in the quality of the bricks produced, and asked whether this was obviated in the present machine ; it would be an important point gained if these difficulties in applying machinery to brick making could be successfully overcome.

Mr. CLIFT thought that much of the difficulty experienced in the use of other brick-making machines arose from the employment of dry clay for making the bricks, in which case the clay was required to be previously dried and prepared for the machine ; while at the same time some doubt had been felt whether dry-clay bricks were not of too close a quality to allow of their being thoroughly vitrified in burning. In hand-made bricks and the bricks made by the machine now described, the clay was more open, not having been dried before moulding, and not having been subjected to a heavy pressure in moulding ; and the moisture being dried out in burning, the heat could more easily get to every part of the bricks so as to burn them thoroughly.

Mr. C. MAY considered the defects of brick-making machines applied more particularly to dry-clay machines, in consequence of the greater complication of machinery required, and the greater difficulty of burning the bricks sound and strong, than with moist clay. He thought the machine now described was a very good one, simple and complete in its action ; but doubted whether bricks could be moulded at so low a cost by machinery as by hand, since they were already made so cheaply by hand that there was not much margin for saving by the application of machinery. He also was not satisfied as to the safety of the conclusions drawn with regard to the number of bricks that could be regularly produced by the machine ; for though 20 good bricks per minute might no doubt be made, it did not follow that 12,000 bricks per day could be made during an entire year ; and the actual results of a year's regular work were required, in order to obtain a fair average. A variety of disturbing circumstances might be met with in the same brick field ; the clay might be drier or containing a greater quantity of stones in one place than in another, which would make a considerable difference in the rate at which the bricks were turned out by the machine. The machine now described was certainly one of the best he had seen for working raw clay direct

from the pit : a more severe pressure might perhaps be employed with advantage, to obtain a superior finish in the bricks. The samples of bricks exhibited from the present machine he observed were many of them unusually heavy, which would be considered an objection in building.

Capt. GOULD said he had seen a quantity of bricks made by one of these machines at Cobham, of the same size as the ordinary London bricks, for the purpose of being laid with them ; the size of the bricks would be determined by the size of mould employed.

Mr. E. A. COWPER enquired what was the total cost of making bricks by the machine, taking the actual make of a long period, including the charge for the machine.

Capt. GOULD replied that the cost of brick making varied much according to the price of coal in different localities ; but there was very little variation in the price of the unburned bricks made by the machine, the difference arising mainly from the varying amount of royalty charged on the clay in the pit, which varied from 1s. to 2s. 6d. per 1000 bricks. With the machine at Cobham, which was employed by Messrs. Peto and Betts upon their works and coming under his constant observation, he considered that the total expenses exclusive of coals would not have exceeded £864 for a year of 261 working days, including all wages and interest on capital, had not the machine been at too great a distance from the clay pit, requiring four barrow men to keep it supplied with clay, which added considerably to the amount paid in wages. The machine had now been at work without intermission for six months, and the rate of production had reached 200,000 bricks in a fortnight of 11 days ; the average number per week of 5½ days was considered to be about 80,000, or at the rate of 24 bricks per minute. The contract for the bricks in and out of the kilns, exclusive of the cost of the coals, was first taken at 5s. 9d. per 1000 bricks ; which was afterwards increased to 6s. 9d., owing to the distance of the clay from the machine. To this had to be added 6d. per 1000 royalty, and the wages of the engine driver at 6d. per 1000, raising the expenses to 7s. 9d. per 1000 bricks. The quantity of coals required for burning the bricks and for the engine driving the machine might safely be taken at ½ ton per 1000 ; and the price of coal there

being 25s. per ton, the total cost of making the bricks by the machine amounted to 20s. per 1000, including the burning. This was the actual result obtained with the machine at Cobham during six months' continuous working; and the rate of production having been as many as 200,000 bricks in 11 days, he was convinced that 20 bricks per minute could be fully depended upon as quite on the safe side.

Mr. W. MAY asked whether the cost of 20s. per 1000 included the interest upon the cost of the establishment and the engine for driving.

Capt. GOULD replied that the interest on the entire outlay of capital and the whole of the expenses involved were reckoned in the cost of 20s. per 1000 bricks, including the 16 horse power portable engine for driving the machinery.

Mr. J. MANNING had obtained the actual cost of labour in working some of the machines during a considerable period, having ascertained the cost of each process. In one instance the total cost of labour amounted to 5s. 6d. per 1000 bricks, including digging the clay, winding it up an incline from the pit, passing it through rollers, wheeling it to the machine, stacking the bricks in the kiln, and afterwards drawing them when burned; the rate of wages being about an average of those paid in the manufacturing districts. In another instance the total cost of labour amounted to 6s. per 1000 bricks, out of which 10d. per 1000 had to be paid for wheeling the clay from one part of the establishment to another, owing to bad arrangement of the premises; had the ground been properly laid out, this item might have been reduced to 4d. or 2d. per 1000, reducing the cost of labour to 5s. 6d. or 5s. 4d. Hence the cost of labour might be safely taken at from 5s. 6d. to 6s. per 1000 bricks; and the total cost per 1000 bricks would then be obtained in any instance by adding the royalty on the clay and on the machine, together with the cost of $\frac{1}{2}$ ton of coals for burning the bricks and driving the machine. The greatest variation was in the cost of coal, which varied from 4s. per ton in the mineral districts to 18s. or 20s. per ton in the neighbourhood of London.

Mr. H. G. LONGRIDGE asked whether with the machine the clay had to be turned over and tempered by exposure for a winter, as for hand-making, or whether it could be used direct from the pit.

Mr. CLIFT said that in the Oldbury district the clay was not tempered, but simply passed through the crushing rollers and fed direct into the machine.

Capt. GOULD stated that in the case of the machine at Cobham the works had been started only six months, so that there had been no time for tempering the clay for all the large quantity of bricks that had been made by the machine in that time, and the clay was fed direct into the machine without any delay for preparation. The material worked at Cobham, of which a specimen was shown, was very unfavourable for brick making, and great difficulty was experienced at first in stacking the bricks for burning, as the clay was so weak and friable that hand-made bricks made of it were crushed by the slightest pressure. The machine however had the advantage of enabling bricks to be made by it in districts where the material did not admit of their being made by hand; and from the trials already made with the machine in different localities he was satisfied that any description of brick earth, from the stiffest and most sticky London clay down to the driest sandy material, could be successfully worked by the machine. He exhibited a brick made for trial of an extreme quality of material, which contained 84 per cent. of pure silica held together only by a little white powder, and without any alumina in it.

Mr. C. MAY asked what the remaining 16 per cent. of the clay consisted of, as it was important to know the other constituents; for if the clay consisted of such pure silica, free from alumina, it would be an invaluable material for making firebricks.

Capt. GOULD did not remember what were the other constituents of the clay, but had understood there was no alumina at all in it. The silicious brick was made in the machine at Oldbury, but the clay was from Tenby in South Wales.

Mr. W. HAWKES observed that an important quality to be considered in all bricks was the extent to which they absorbed water, since it was impossible to build dry houses with bricks that absorbed water readily. The absorption of ordinary bricks was about 1-9th of their weight, or a brick of 9 lbs. weight would absorb about 1 lb. of water. The bricks made by the machine appeared to be heavier than the ordinary hand-made bricks of the same dimensions; and he enquired whether

their power of absorption had been ascertained as compared with ordinary bricks.

Mr. OATES said he had not measured the absorption of the bricks made by the machine, but believed it would be less than that of hand-made bricks, since it appeared from the fracture of the machine-made bricks that they were more uniformly burned throughout.

Mr. C. MAY observed that in comparing different bricks it would be necessary to be particular as to the size of the bricks referred to, since there were great differences of size and an entire absence of uniformity in this respect. He found by measurement that among the bricks now exhibited one contained only 85 cubic inches and another as much as 139 cubic inches, whilst the generally received standard of size, measuring $9 \times 4\frac{1}{2} \times 3$ inches, contained 121 cubic inches. All the expenses of manufacture were directly affected by the size made; and in the case of the small sized London bricks 1 ton of coals was sufficient to burn 3000 bricks, so that the estimate of $\frac{1}{2}$ ton of coal per 1000 was too high in that case. As to absorbing power also the same discrepancies would be observed in consequence of differences of size: but he did not think there was any brick not purely vitrified throughout that would not take up a considerable proportion of water. Ordinary hand-made bricks often took up as much as 1 lb. of water, when tried long enough to become saturated; and if the bricks made in the machine absorbed less in consequence of being harder burned, then a larger quantity of coal must have been consumed in burning them to the greater degree of hardness.

Mr. CLIFT said the bricks referred to throughout the paper were the large size bricks shown, containing 139 cubic inches; these were made in the machine at Oldbury at a regular rate of 20 good bricks per minute, which was a safe average of several months' continuous work during wet and fine weather. There would necessarily be some variation in size of the bricks made by the same machine, arising from the different degrees of shrinking in burning, which would depend upon the position of the bricks in different parts of the kiln.

Mr. W. HAWKES thought it was important to fix on some standard dimensions for bricks, that they might be fairly compared in strength and other qualities; and suggested the common dimensions

of $9 \times 4\frac{1}{2} \times 3$ inches as most suitable. From experiments that he had made on the strength of different sorts of bricks it appeared that the Boston American brick, which was one of the smallest in size, measuring only $7.5 \times 3.4 \times 2.2$ inches, was one of the strongest under a transverse strain, the average transverse strength of four being 2008 lbs.; while the transverse strength of a St. Petersburg brick measuring $10.0 \times 4.8 \times 2.8$ inches was only 880 lbs., both being calculated at 7 inches distance between the bearings. If these were reduced to one common size of $4\frac{1}{2} \times 3$ inches transverse section with 7 inch bearing, the mean strength of the four Boston bricks would be 4942 lbs., and the strength of the St. Petersburg brick 947 lbs. or less than 1-5th of the former. In testing bricks both the transverse and crushing strength should be tried, as the bricks had to stand both strains in practice, but were not equally able to resist them both. The absorbing power of bricks should be tried by 24 hours' immersion in water, which he believed was the practice with some of the London builders, in order to obtain a reliable result by ensuring their complete saturation.

The CHAIRMAN remarked that he had seen a brick-making machine working near Norwich, invented by Mr. Hodson of Hull, consisting of a common pugging mill with the knives or cutters set so as to force the clay through a mould at the bottom, the size of the brick being regulated by a spring platform on which it was delivered and cut off by hand; the machine was driven by a horse and seemed to take but little power and was an inexpensive construction, and he understood it was satisfactory and economical in working.

Mr. OATES said in his early trials upon the plan of the present machine he had made one to be worked by a man with a 5 feet lever, which required very little power to work it with soft clay, and he had still got some of the bricks then produced; the clay was purposely made as soft as for hand-made bricks, but the bricks then required a drying process before stacking in the kiln, just as in hand-making. When the clay was used drier in the machine, so as to save drying afterwards, more power was wanted and an engine had to be employed to work the machine.

He showed a working model of the pressing screw and escape pipe

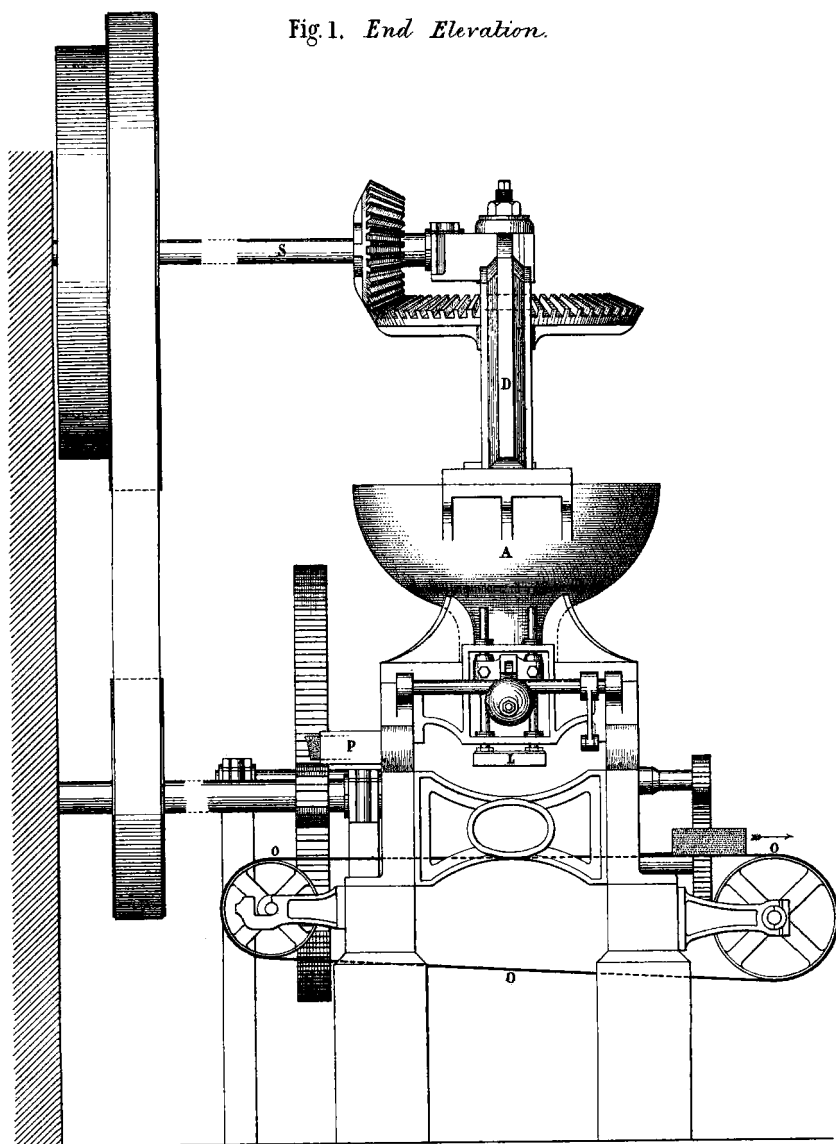
of the machine, showing the regular action of the vertical screw in forcing out laterally through the horizontal pipe a column of clay of uniform density.

Mr. E. A. COWPER asked what was the cost of the machines, and how many there were at work.

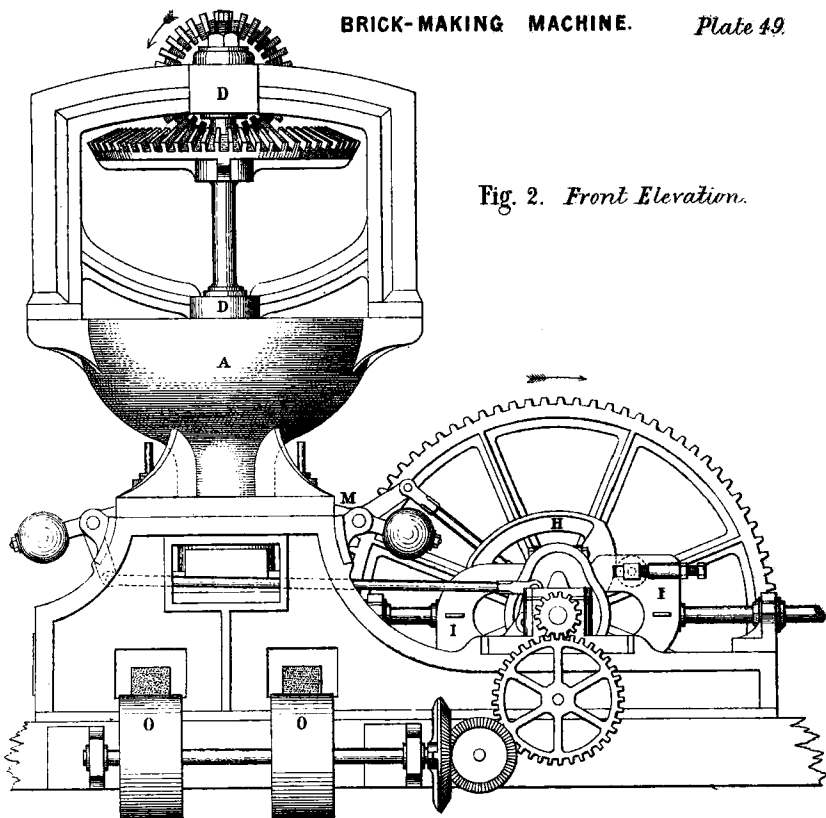
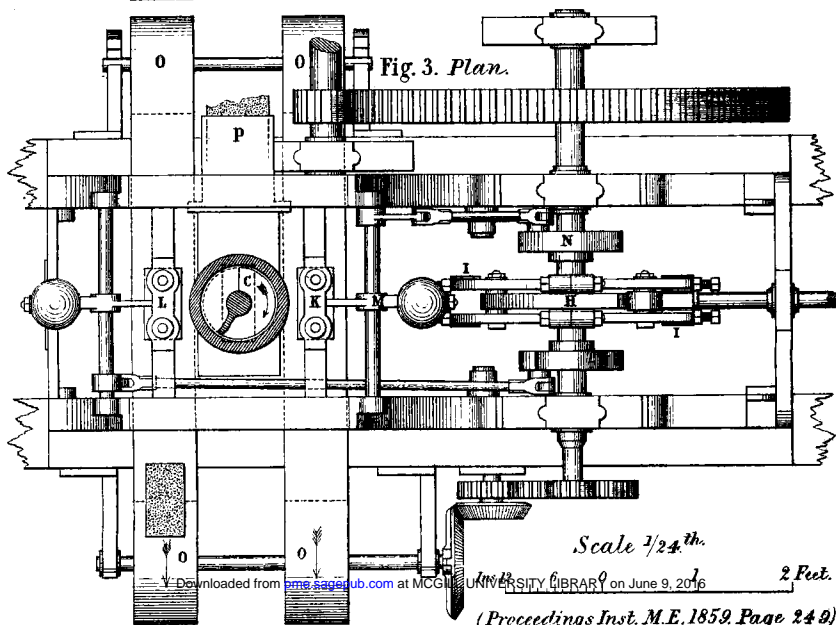
Mr. OATES replied that the cost of the machine was from £150 to £200, exclusive of the engine for driving it. There were now 14 of the machines at work in different parts of the country, some of which had been working regularly for three years. The wear of the screws varied considerably according to the quality of the clay; in one instance the screw had lasted for as many as 2 million bricks, but with a very silicious material it would not last nearly so long, and one screw would not make more than 250,000 bricks with a clay containing much silica.

The CHAIRMAN proposed a vote of thanks to Mr. Clift and also to Mr. Oates, which was passed.

The following Paper was then read :—

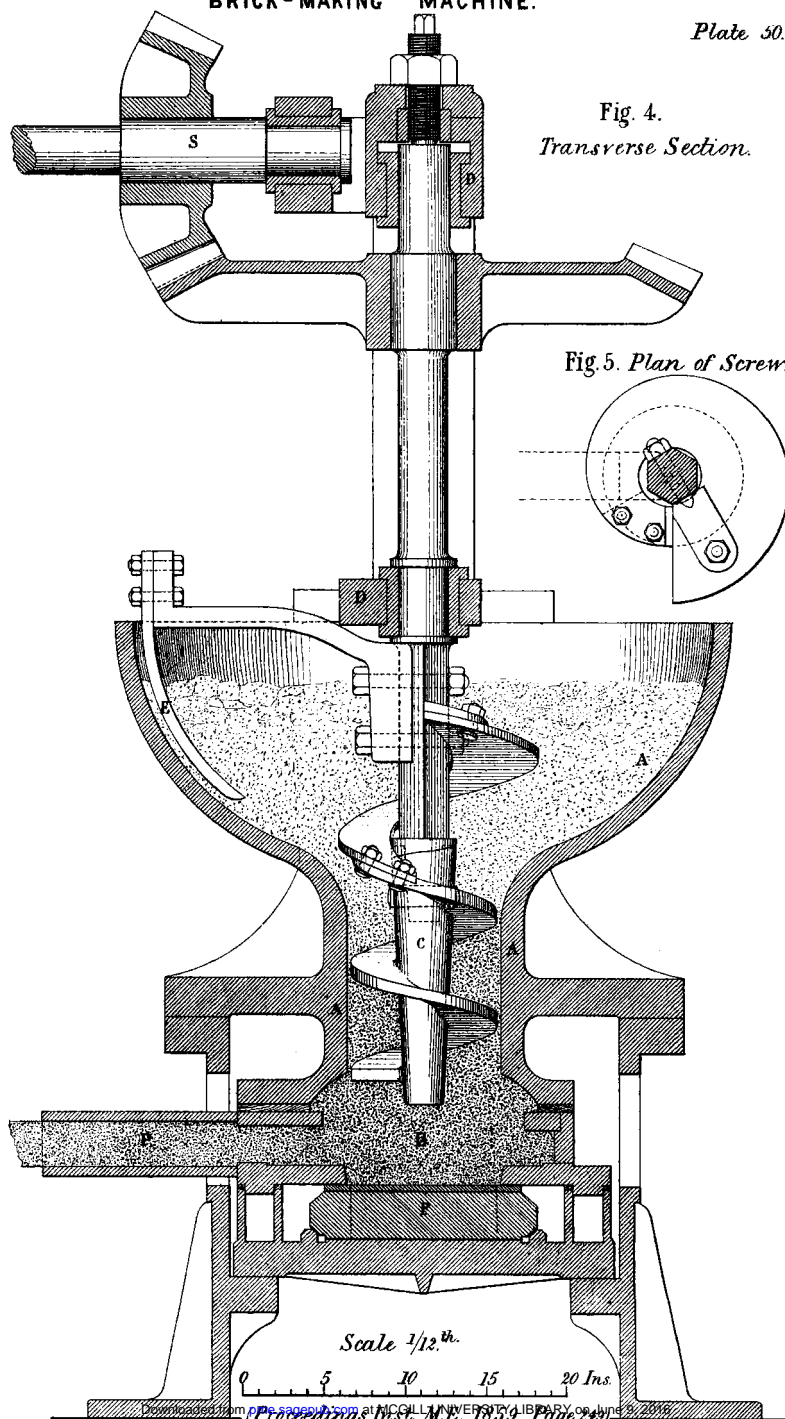
Fig. 1. *End Elevation.*

Scale $\frac{1}{2}$ in. = 1 ft. 12 in. 6 0 1 2 3 4 5 Feet.

Fig. 2. *Front Elevation.*Fig. 3. *Plan.*Scale $\frac{7}{24}$ th.

2 Feet.

Fig. 4.

*Transverse Section.*Fig. 5. *Plan of Screw.*

BRICK-MAKING MACHINE

Plate 51.

Fig. 7.
Cams
for working
Pistons K and L.

Fig. 6.
Longitudinal
Section.

