SECTION III.

To convert a given direct, and equable rectilinear motion, or the velocity of which varies by a given law, into direct circular motion, of velocity similar to that of the moving power, either equable or variable by a given law, and in the same or in different directions.

THE re-acting engine of Segner gives a direct solution of the problem ; and Mour's centrifugal machine, noticed by Euler, in the Memoirs of the Academy of Berlin, for the year 1751, gives a solution of the inverse problem ; both these, therefore, class themselves in this Section.

(A 3.)

A cylinder having a motion on its axis, and a rope winding on its surface, gives a general solution of this, and the inverse problem. The arrangement is sufficiently familiar to render a more detailed description unnecessary.

(B 3.)

The cord used in the preceding movement is here superseded by an endless chain furnished with projecting teeth, which engage in a toothed wheel, affixed to the end of the cylinder.

(C 3.)

A NUT AND SCREW.

If the nut of a screw be fixed, and the screw be turned within it, the screw will have a motion which is composed of its own rotation on its axis, and the conversion to direct rectilinear motion. Thus it is used in the arts to penetrate hard substances—to draw or force them together—to lift heavy burthens—and in some of the tools of watchmaking, as drills. The axis of the drill is so placed that its ends are supported by two screws, the nuts of which are confined or held between the puppets of a lathe. The two screws being turned by this means in opposite directions, communicate to the drill the required rectilinear motion. Another method, which is much to be preferred, is to support the drill by two steel cylinders which pass through the puppets of the lathe, and close to these are placed two screws, the nuts of which are also held by the same puppets. The heads of the screws are in this case of sufficient size to press against the ends of the two cylinders which support the axis of the drill; and when turned in opposite directions gives to the drill the required motion, and in a more steady manner than was afforded by the preceding method.

If the screw be turned without being suffered to change its place, the nut must not be allowed to turn, but to have liberty to move in the longitudinal direction of the screw, and in this case the circular and rectilinear movements are divided, and a direct solution of the problem is obtained: the circular movement being converted into rectilinear. A rotatory motion of the screw may also be produced by giving the nut a rectilinear motion, but the friction of this motion is so considerable that it is seldom practised.

It is frequently required to bold a screw and its nut together, so that no change of their relative positions may take place by accident, carelessness of workmen, or by any violent motion or shock which might be produced by the machine; this is effected in a very simple manner by means of a second nut, which screws close upon that which is required to be fixed; the first nut is thus continually pressed forward in the longitudinal direction of the screw by the second nut, and the friction between the first nut and the screw, being as already observed, very great, the action exerted is not sufficient to overcome the resistance; the re-action of the nut, which is pressed upon, operates upon the tightening nut, and the resistance encreasing with the pressure, they both become fixed.

The screw is one of the mechanical powers of the most general use in the arts; there are few in which it is not rendered useful, and it varies its character of usefulness: sometimes having relation to the mechanical composition of the instrument, sometimes to the purpose for which it is to be used.

An arrangement of two screws placed parallel to each other is frequently used to produce the parallel motion of a plane of considerable length.

Presses for different purposes are constructed on this principle. In the 4th volume of the machines approved by the Academy of Sciences we find the application of the screw to the construction of a press, proposed by M. Jacques Le Maire: the editor of that work observes, that this method of applying the screw is extremely ingenious, that it would be found useful in a great diversity of ways, and will produce the most striking effects. He states M. Le Chevalier De Ville to be the inventor, who employed it for the purpose of forcing barricadoes: and has shewn the method of application in his treatise entitled—" Traité de Fortifications de l'attaque et de la defense des places," page 238, plate 37. Printed at Lyons 1629. Descriptions of it will also be found in other works.

If two threads be cut on the same cylinder in opposite directions, they will move two nuts at the same time, also in opposite directions.

(D 3.)

A method of converting circular into rectilinear motion with an extremely low velocity has been discovered by M. Prony. It is by means of this contrivance that we are enabled to avoid the necessity of using screws of an unusually fine thread, to procure a slow adjusting motion. The disadvantages arising from the use of such screws were formerly very great; the rapid wear and consequent inaccuracy of the usual micrometers was an instance of the ill consequences produced by that circumstance. It is also capable of many other practical and useful applications. The original idea of the inventor is extremely simple and elegant.

A B is an axis or spindle divided into three portions a b, c d, e f. The two screws ab, e f, are of the same thread: they pass through the two fixed supports C D, in each of which there is a nut; the spindle has an horizontal motion, and at each revolution of the screw moves over a space equal to one of its threads; the portion cd, is formed into another screw, the thread of which may either be a little finer or a little coarser than that of the screws a b, e f, and the difference may be small at pleasure. A nut M is introduced, in which the threads of a micrometer are fixed: this nut being checked by the block E F, is not at liberty to turn with the spindle A B, which it would otherwise do: but at each revolution of the spindle moves a space equal to one of its own threads, its rate of motion is therefore compounded of the actual and relative advance of the spindle A B: so that it really moves but the amount of the difference between those motions.

This is M. Prony's simple and ingenious solution of this problem.

In practice it will be found difficult to make the two screws a b, and e f, so accurately alike, that there shall be no resistance in the nuts: one of these might however be omitted, that portion of the spindle being in that case made plain or cylindrical.

(E 3.)

A spiral winding about a cylinder, and exposed to a current of air or water, will convert the rectilinear motion of those fluids into a circular motion. The spiral of Archimedes may be considered as the inverse of this problem *.

The process of constructing this spiral may be found in the collection of machines approved by the Academy of Sciences of Paris, vol 7, No. 479. This method is there proposed by M. Dubost, for the construction of a mill upon the Rhone. In volume v, No. 338, of the same work, M. Du Quet proposed it for the construction of a machine intended to raise sunken vessels. It is also applied to the operation of turning the common jack used in our kitchens, by means of the current of air which continually passes through the chimney; and to other machines for the purposes of the log instrument, for measuring the progress of maritime vessels †.

(F 3.)

Vertical water wheels, with plane floats.

(G 3.)

Horizontal water wheels, with curved floats.

(H 3.)

Over-shot water wheels.

M. Borda in a memoir on water wheels, printed in the Memoirs of the Academy

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* The theory of the screw of Archimedes may be seen in L'Hydrodynamique de Daniel Bernoulli. A memoir by Pitot, in the memoirs of the Academy of Sciences for 1736;—another by Euler, in the memoirs of the Imperial Academy of Petersburgh, vol. v. for the year 1754.—A work by P. Belgrado, entitled "Theoria cochleæ Archimedis; ab Observationibus, Experimentis et Analyticis rationibus ducta, 1767."—The premium of the Berlin Academy in 1765, adjudged to M. Jean Frederic Hon-nerol;—and the work of Paucton, on the Theory of the Archimedian screw.

† See Theatrum Machinarum de Leupold, vol. i. plate 51. Theatrum machinarum novum, &c. per Gregorium Andream Bocklerum, 1662, fig. 81, 82.—Designs for Wind and Water Mills, &c. by Jacques de Strada, published by Octave de Strada. Frankfort, 1617, fig. 49.

of Sciences of 1767, has given many important calculations on the subject, shewing the most effective mode of applying the moving powers to such wheels, and their effects under different circumstances; and closes his memoir with the following reflections on the practical application of his researches.

OF VERTICAL WHEELS WITH PLANE AND INCLINED FLOATS.

Such wheels are capable of producing the half of the maximum effect, if the floats moving in their channel exactly occupy the whole passage, allowing no particle of the water to escape without communicating to them its excess of velocity; but it is necessary to allow a small space sufficient to avoid the collission of the floats with the bottom and sides of the channel; although this at the same time allows a portion of water to escape which has not exerted any action. It is difficult to determine the diminution of effect produced from this cause, since it depends more or less on accuracy of workmanship; but it seldom happens that the practical effect of such wheels is more than three-eighths of the maximum effect, although in theory it may be considered equal to one half.

OF HORIZONTAL WHEELS WITH PLANE FLOATS.

These wheels do not lose by a great deal so much of the action of the water as the preceding ones, and should consequently be preferred where the quantity of the fall, or other circumstances will allow the equal choice. They have also the advantage of being susceptible of a considerable encrease of their velocity according to its required action on the machinery to which it is applied, instead of the constant velocity of one half of that of the current, which suits the maximum effect of vertical wheels.

OF HORIZONTAL WHEELS WITH CURVED FLOATS.

These wheels have not the advantages over those of the preceding form which theory assigns them; because in practice it is nearly impossible that the whole of the water should enter the curves—conform to their figure—and leave them in an horizontal direction: all which circumstances must take place for a maximum effect to be produced. Notwithstanding these, and other defects which it would be tedious to detail, these wheels are always of superior effect to horizontal wheels with plane floats; and in cases where a copious or sufficient fall of water can be obtained, they are certainly preferable to the usual vertical wheels in a still greater degree. For example—I am persuaded, it is perfectly practicable to construct an horizontal wheel with curved floats; the effect of which, with respect to a vertical wheel of the common construction, shall be at the lowest estimation in the proportion of three to two.

OF OVER-SHOT WHEELS.

It is explained by M. Borda in the memoir we are now adverting to, that if a water wheel of this class be required to produce its maximum effect, it will be necessary to observe the three following conditions:—1. That its diameter be equal to the height of the fall of water; or it may even be taken at somewhat more than that dimension. 2. That the current of water shall enter the buckets at the level of the surface of the reservoir. 3. That the velocity of the wheel be exceedingly small: but although the maximum of effect can in fact be produced only when these conditions are actually fulfilled, a gentle fall of the current or water, and a sufficient velocity of the wheel may nevertheless be admitted without reducing the effect of the wheel materially below its maximum of effect.

The author assumes for the purpose of an explanatory example a wheel of 11 feet in diameter, which he places in such a manner that the surface of the reservoir shall be situated at 12 feet from its lowest point, and that the first action of the water shall take place at the highest point of the circumference; and supposing the buckets to be allowed a velocity of 4 feet in each second of time, the resulting effect will be to the maximum effect as 11 to 12. But if it should be required to encrease the velocity to that of 6 feet in each second of time, it will in that case be found that the maximum effect will be reduced one-tenth.

He observes that it is thus shewn that bucket wheels do practically produce very nearly a maximum effect, whereas vertical wheels of the usual construction produce at most but three-eighths of the maximum effect; and that the two classes of horizontal wheels produce one of them somewhat more, the other a little less than half the maximum effect.

It is observed finally by M. Borda, that the practical application of the different sorts of hydraulic wheels here described, depending on a fall of water disposable at pleasure, on the nature of the machinery to which they may be required to be applied, and on many other local circumstances; no statement of general advantages can be made in favour of any of them, but that from the general principles he lays down in his memoir, a correct comparison of their merits can easily be made for any case which may occur.

(I 3. Plate 2.)

OF HORIZONTAL WIND-MILLS.

There is perhaps no machine more universally known than the wind-mill; or at the same time any machine of which the true theoretical principles are so little understood, and which are subject to such various inconveniencies. The vanes of this machine are turned by the direct impulsion of the wind; but the power which acts to produce this motion, is frequently less than that which tends to overturn the machine. From this circumstance there results the necessity in constructing the vanes, of making them of excessive dimensions: such enlarged dimensions greatly encreases the quantity of friction, renders the working with high winds both difficult and dangerous, and in the event of hurricane even exposes the whole machine to destruction.

The size of the wings occasion a very considerable lateral resistance; and if the obliquity be considered which it is necessary to give them in order to obtain the maximum of effect, it will be seen that on account of this considerable surface of the wings, the effect of the mill is seldom what might be expected. The necessity of constantly directing the wings to the wind is one of the greatest inconveniencies; as the wind is continually varying, its direction is seldom such as is required. It sometimes may be found even to shift suddenly to the opposite point of the horizon: in such a case, the mill is in great danger of being destroyed; besides this, the inconveniences of the capstern, and the difficulty of working it with sufficient alertness involves much unprofitable labour, and occasions much loss of time.

In wind-mills of small size a set of vanes are sometimes used, which enable the wings to direct themselves to the wind; so that from whatever point it proceeds they immediately assume their proper situation. In England this is generally effected in large mills by a small set of vanes acting on a large horizontal toothed-wheel by means of an endless screw; but large vanes of this description, when applied to mills of small size, as well as small vanes, when applied to mills of large size, present obstacles of too serious a nature in their construction on the one hand, and of expence on the other, to meet with general adoption. These circumstances have engaged the attention of mechanical men, who have sought the means of some more advantageous use of the power of wind, which might enable a mill to direct itself constantly to the wind without the necessity of any manual operation. One of the most remarkable of these is a Dutch mill, in which is a horizontal wheel with moveable wings: a certain number of these are constantly in the direction of the wind, while the others are entirely exposed to its impulsion, and consequently force the wheel round till the power ceases, or some other cause stops the motion of the wings.

In the figure I 3, let us imagine—1st. That C 1, C 2, C3, C4, C5, represent a wheel composed of six frames set upon the spindle C. 2nd. That e k, d y, b i, a h, g m, and f l, are small vanes fixed to the same frame by their pivots d', and that they are placed in such a manner that the vanes are divided into two unequal parts by their axis of rotation.

Let there be placed in each frame a check or stop as r r, &c. formed by vertical ropes at such a distance from the center as that the distance between the check and the pivot of the vane, which belongs to that frame, shall be a little less than the length of the longer arm of that vane. The vane will consequently be at liberty to turn freely on its pivot, without however being allowed to pass beyond the direction of the supporting frame: which may be easily effected by introducing other checks, such as other ropes placed between those last mentioned and the point of rotation.

It will be easily perceived that in whatever position the small vanes may be during a calm, the moment the wind begins to blow, in whatever direction, the vanes will of themselves assume their proper direction, by causing the spindle C, to turn constantly the same way: this is a circumstance of great importance, and would certainly have given this description of wings a decided advantage over vertical wings, if serious inconveniencies incident to them had not materially lessened their value. That which we consider as the most important, is the considerable resistance which takes place between the wind and that portion of the wheel which places itself opposite to its direction. The continual shocks produced by the striking of the vanes against the check ropes, also diminish the general effect of the machine, and tend to its destruction.

It has been unsuccessfully attempted to diminish these consequences by encreasing the number of vanes upon the same frame; but daily experience shews us, that the general inconveniences attending horizontal wind-mills overbalance their advantages.

(K 3.)

OF WIND-MILLS WITH VERTICAL SAILS.

These mills are composed 1st of a moveable axis B, inclined to the horizon from 8 to 15 degrees. 2nd. Of four bars or arms of wood B C, B D, B E, B F, each of about 37 feet in length, which are set at right angles to the axis B, near its highest extremity. And 3rd, of four wings, which are supported by the last mentioned pieces.

The wings are each 31 feet in length, by a little more than 6 feet in breadth; and extend from 6 feet above the axis B, to the extremity of the bar.

According to Messrs. Monge and Hatchett each wing may be considered to be a bent or waved surface, generated by the motion of a right line perpendicular to the piece which supports the wing. At the extremity nearest to the axis B, the wing makes an angle of 60 degrees with it on the windward side. The generating line traverses with an uniform motion the whole length of the piece which supports the wing, always remaining perpendicular to it, but uniformly encreasing the angle which it makes with the axis B, until arrived at the extremity of the wing. It forms an angle of 78 degrees with it, if the axis B is inclined 8 degrees, or of 84 degrees if the axis B is inclined 15 degrees; and in proportion for any intermediate inclination.

The several positions of the generating line spoken of, will give the position of each cross-piece of the frame which receives the sail of the wing.

Each wing may thus be considered a waved surface, generated by the motion of a right line perpendicular to the supporting piece, and coinciding in every part of its progress with a right line drawn between the corresponding extremities of the generating line at the two extremitiesoof the wing as already described.

The dimensions here given are those which are generally adopted in Flanders, in the neighbourhood of Lisle; and are described by M. Coulomb, in a memoir of the Academy of Sciences for 1781, to which we refer the reader.

In calculating the total effect of these mills, he estimates that they will raise 1000lbs. weight 218 feet in each minute of time, working constantly at the rate of eight hours each day.

M. Coulomb observes with M. Bernouilli—supposing a man to use his power in the most advantageous manner, and to work eight hours per day, he will not be able to raise more than 60lbs. weight in each second of timeo which, producing 1,728,000lbs. weight raised to the height of 1 foot, for the daily effect, we shall have upon the calculation of 8 hours' labour in each day, a total weight of 1,000lbs. raised to the height of three feet and six-tenths in each minute; and as we determine that the mill in question working at the rate of 8 hours per day, will raise 1000lbs. weight to the height of 218 feet in each minute, its whole effect will equal that of the daily labour of sixty-one men.

In the memoirs of the Academy of Berlin for the year 1756, we find a memoir of M. Euler on the theory of wind-mills: in which he determines that the wing should form an angle of 54 degrees 44 minutes, with the supporting shaft at that point of the wing immediately contiguous to it, that at its extremity it should form with the shaft an angle of 80 degrees; and that the velocity of the extreme point of the sail should be somewhat more than twice that of the wind.

A memoir of M. Lambert, in the memoirs of the Academy of Sciences of Berlin for the year 1775, may be advantageously consulted on this subject.

The dimensions of the wings of wind-mills, their form, the methods of adjusting them to the direction of the prevailing wind, the means afforded of spreading, and of taking in the sails, are likewise considerations which have constantly engaged the attention of mechanicians and men of science.

The following works may also be beneficially consulted:

Leupold Theatrum Machinarum.

Description de l'art de construire les moulins, by Beyer; enlarged by Weinhold. Dresden, 1788, in folio.

Dessins artificiaux des toutes sortes des moulins à vent, &c. by Jean de Strada de Rosbery. Published by Octave de Strada, Frankfort, 1617, and 1629, in folio.

Theatrum machinarum novum, &c. by Gregorium Andream Bocklerum, 1662. This work also contains the greater part of the machines described in Strada's work. Bockler also published a work in folio, under the title of "Architectura curiosa nova," which contains a collection of such fountains as are remarkable by the variety of their arrangement and effect.

Schapp's work, entitled "Theatre des Moulins;" the mechanical portion of the first part, with five supplements. Frankfort, 1766, in quarto.

There are few collections of machines which do not contain accounts of various constructions of wind-mills *.

A description of two mills, which deserve some attention, will also be found in the Annales des Arts et Manufactures, Nos. 20 and 41.

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* As for example—in the "Collection des machines approuvées par l'Academie," in vol. i. pages 105 and 107; and in vol. vii, page 117.

(L 3.)

A description of a steam engine with a direct motion was contributed to the account of productions of the national industry, by M. Verzy in the year 1806, and which we shall now describe:—

Let a b c d be the section of a cylinder taken at right angles to its axis, and let the height of the cylinder be equal to the distance m n, which is the space that separates the cylinder a b c d from a second cylinder e f g h i e, situated concentrically within the first; so that the two cylinders have one common axis, and the surface of the second is accurately adjusted to the upper and lower edges of the first or outer cylinder.

Between the two cylinders there is thus a sort of circular channel, the horizontal section of which is represented in the figure by k e b f b l m n k e, and the height equal to the plate m n, which is attached to the outer cylinder and breaks the continuity of the circular channel already mentioned: the ends of the interior cylinder are closed by plates of metal, which form a small border or ledge on the upper edges of the exterior cylinder. They are attached to the axis C, so that the interior cylinder may be at liberty to turn freely about on its axis, supposing the exterior cylinder to remain fixed.

In the curved surface of the interior cylinder are made two apertures e i, g h, diametrically opposite to each other; and in width and height equal to the circular channel or passage already spoken of. Two shutters or valves of an angular form k e i, g h l, are provided, which turn on their axes e and h, and act so as to close the apertures e i and g h, and also the circular passage at the same time by means of two spiral springs e p q, h r s, fixed on the upper extremities of their axes, and the elasticity or force of which may be encreased or diminished at pleasure. These axes project above the upper face of the cylinder, and have each a lever handle which respectively project from the axis in the directions e k, h l.

The curved surface of the exterior cylinder is perforated by two circular apertures, one which terminates the tube A, which conveys steam to the cylinder, and the other communicating with the condenser by means of the tube B.

This being clearly understood, if we imagine that steam enters the cylinder by the tube A, the plate m n obstructs its passage, whilst the two sides or arms k e, e i, of the angular valve presents the same quantity of surface, and consequently the valve will not alter its position; but its edge will press on that of the interior cylinder with the whole force of the spring e p q, and that cylinder will revolve about the common axis of the two cylinders, and in the direction a b c. Before k e arrives at the aperture B, which communicates with the injection pipe, the lever handle at h, will have encountered the obstacle or check at o, which is a small bar or pin fixed to the outer cover of the exterior cylinder, and will have forced the angular valve g h l within to turn inwards: thus passing the fixed plate m n, so that when it re-assumes its first position, k p will have passed the aperture B, and the vacuum will be formed in the portion k e b l r f p of the passage, and every thing will be in the situation represented in the figure. The interior cylinder will only have made a half revolution; the action of the steam will continue to communicate a continued rotatory motion to the axis, which may be applied to any use at pleasure.

Various machines on this plan have been constructed in England for a considerable time. Descriptions of such may be seen in the Repertory of Arts and Manufactures.

(M 3.)

PLAN AND ELEVATION.

The intended effect of this machine is to produce the immediate conversion of the rectilinear motion of the wind into circular motion. It is an universal windmill, but is not so practically useful as it is curious.

(N 3. Plate 10.)

THE MACHINE OF THE MARQUIS MANNOURY D'ECTOT.

The plate consists of an elevation, an horizontal section in the line cc′ of the elevation (marked a in the plate); and a second horizontal section in the line d′d of the elevation (marked b in the plate).

It is well observed by M. Petit, that this machine may be classed among hydraulic wheels:—it consists of a cylindric wooden tub n c d d′ c′ n, the bottom of which has a circular perforation r r in the centre, as represented in the elevation and the section b. Through this aperture there passes an iron spindle pq, which is held at its upper extremity by a collar, and has its lower extremity resting on a pivot, which allows it a rotatory motion on its axis, and carrying the tub with it in its motion, by being attached to it by cross bars of iron, two of which c c′ and e e′ are shewn in the section a, and the other two d d′, f f′ in the section b. The spindle, which lies in the direction of the axis of the tub, does not completely occupy the circular aperture which it passes through, but leaves around it an open annular space through which the flowing water has liberty to escape. A circular diaphragm s s, fixed to the vertical axis p q, and also to the cross bar c c′ e e′ immediately below them, serves to divide the tub into two equal portions in the direction of its depth, as n c c′ n and c d d′ c. These divisions or compartments of the tub. c d d′ c, have no means of communication except by the annular space which remains between the edge of the diaphragm and the inner surface of the tub. The lower portion or compartment of the tuboc d d′ c′, is divided into eight smaller compartments by so many divisions t, four of these proceed immediately from the axis towards the circumference: the other four do not extend so far as the axis, in order not to cause too much obstruction to the opening r r. These diaphragms are composed of flat surfaces, and continue from the circular diaphragm to the lower part of the tub. Water is made to enter at the upper part of the tub by a conduit-pipe B, which is bent in a suitable manner so as to allow it to flow out by an aperture x shewn in the elevation, and in the section a. It flows in a sheet which strikes perpendicularly against the concave surface of that part of the tub, setting the tub in motion, and descending to its lower compartment by the annular space provided between the diaphragms s s, and the inner surface of the vessel, penetrates the eight divisions already spoken of, and finally quits the vessel by the aperture r r, and falls into the discharging pipe R.

This is the description and mode of operation of this machine, which the inventor has adopted in various different instances with perfect success. He has recently added an improvement which consists in substituting for the flat diaphragms t, curved or spiral diaphragms, which extend upwards as far as the upper edge n n of the tub, through the open space in the middle. The figure of these improved diaphragms enables him to dispense with the flanch n n, and which prevented the water from escaping in that direction: it appears that by this improvement the loss of momentum is considerably diminished.

O 3. Plate 10.

M. CAGNIARD LATOUR'S MACHINE.

This machine is composed of two tubs or vessels A and B, the first filled with water at the ordinary temperature, the second filled with hot water the temperature of which is of at least 75 degrees of the centigrade thermometer. In the first tub is placed an Archimedean screw C, and in the second a water wheel D; a tube a b c d e f, communicates from the bottom of the first tube to that of the second.

If the Archimedean screw be turned in a direction contrary to that in which it would be necessary to turn it, in order to raise the water contained in the tub, it will cause atmospheric air to descend by its spiral passage; and this, after passing through the tube of communication a b c d e f, will be delivered at its aperture f. It is hardly necessary to premise that the distance of the aperture f from the surface of the tube B, should be somewhat less than that of the aperture a, from the surface of the vessel A. The cold atmospheric air, carried in this manner to the bottomoof the tub filled with hot water, will under those circumstances, become dilated with the encreased temperature, enter the compartments of the wheel by the open or outer ends, which are turned downwards, and so cause the wheel D to revolve.

M. Carnot, in a report made to the Institute, May 8th 1809, upon this machine, observes thus:—In the machine executed by M. Cagniard, the effect produced is to raise by means of a rope attached to the shaft of the wheel a weight of 15lbs. with an uniform velocity of one inch in each second of time, and in a vertical direction; whilst the moving power applied to the screw is only three pounds weight with the same velocity: so that the effect of the encreased temperature seems to be that of encreasing the natural effect of the moving power five-fold.

We may conceive that the effect of the moving power being encreased five-fold, we may deduct from that effect and add somewhat to the moving power; and still find that we retain a disposeable power of four times the original or moving power, which is what has been effected in M. Cagniard's machine, as will be seen by the figure.

This application of the Archimedean screw produces one of the best arrangements for blowing engines. At Clichy we find it adopted in a manufactory of white lead in which the screw is of the dimensions of four feet in diameter, and five feet in length.

(P 3. Plate 10.)

The appellation of Crab, is given to a machine composed of an horizontal roller, which is used to lift heavy weights, either by means of a simple pulley, or sometimes with the additional help of combined pullies of different powers; these machines afford a general solution of the problem proposed to be resolved in this section.

We have in this instance a machine of this description, in which the required effect as to the relative velocities is not produced by the use of a compound pulley, but by substituting for the ordinary cylindrical roller, a roller which consists of two cylindrical portions of different diameters, and on one common axis: see A E in the figure. A rope A B C DE, after making several turns on the portion A of the roller, passes over the simple fixed pulley B, and thence to the simple moveable pulley D, to which is attached the weight P; it then returns, and passing by a second fixed pulley C, goes finally to the other and smaller portion E of the roller A E, on which it is wound up in a contrary direction to that in which it was wound on the first portion A; so that when the cylinder is made to revolve on its axis, the rope is wound up, or gathered upon the portion A of the roller, while it is unwound or released from the portion E. The moving power is applied to the extremities of the levers I I. It will be easily conceived that at each rotation of the roller A E, the weight P will move through a space equal only to half the