that is continually varying from 0 to a maximum, and from a maximum to 0, through every successive quadrant of the circle. The amount of the variation is shown in the following table:—

|  |  |  |
| --- | --- | --- |
| Points in the figure. | | Pressure in direction of revolution. |
| 0 and at 20 | | 0.00 |
| 1 | ... 19 | 30.90 |
| 2 | ... 18 | 58.78 |
| 3 | ... 17 | 80.90 |
| 4 | ... 16 | 95 11 |
| 5 | ... 15 | 100.00 |
| 6 | ... 14 | 95.11 |
| 7 | ... 13 | 80.90 |
| 8 | .... 12 | 58.78 |
| 9 . ... | ... 11 | 30.90 |
| 10 | .... 10 | 0.00 |
|  | Mean pressure 63.11 | |

The mean pressure on the crank being in the table about 63 pounds, taken on an average of the whole circumference of the circle, the pressure varies from 36 pounds above the mean, to 63 pounds below it. The total pres sure of the steam in the cylinder, forces the connecting rod up and down through a space equal, each time, to the diameter of the circle, while the connecting-rod carries the crank through a space which is equal to the whole circumference ; and as the circumference of a circle bears to twice its diameter an approximate ratio of 100 to 03, it follows, that the pressures on the crank and piston are inversely as the spaces through which they move; the mo­tive power of steam in the cylinder being 100 lbs. moved through a space of 03, and the motive power given out in the crank, being a mean of about 63 lbs. moved through the circumference of a circle which is represented by 100, so that the motive power is in the one case 100 lbs. × 63 = 6300 lbs., and in the other case 03 lbs. × 100 = 6300 lbs.

The crank is merely one beautiful exemplification of the great dynamical principle, which includes in it the law of operation of all the elements of machinery, “ that in uniform motions the quantities of motive power, or *vis viva,* may be transferred from one point to another, through every variety of direction, velocity, and intensity, by material mechanism, without being thereby altered in quantity, except in so far as friction and imperfect rigidity may diminish its amount by a certain percentage, which diminution it is the aim of all perfect construction and design, in the practical application of machinery, to *re­duce* to the smallest possible amount.” To render uniform the effective pressure given out by the crank, is the object of the flywheel, and of the pneumatic pump of Mr Buckle. For the same purpose many other expedients have been devised ; and the following explanation is intend ed to facilitate the comprehension of the nature and value of these expedients.

The variation of pressure on the crank of a steam engine, may be conveniently represented by curves.

crank be represented by the straight line A X, fig. 128, and divided into any number of equal parts ; let straight lines *y1* y2 *y3* &c., be drawn to represent the amount of pressure converted into the direction of the motion of the crank, according to the line *b* in fig. 127, being the amounts represented in the line of figures, then the curved line A *y y y x* passing through the summit of all these lines will represent the variation in the power of the crank at each instant of time, each ordinate *y1* y2 *y*3 being the pressure, and the area of the whole figure will repre sent the whole motive power, having a maximum of *y5* and y15, and a point of change of direction from pressure one way to pressure the opposite way at *y*10.

Now one method of equalizing the rotative pressure on the crank has been proposed, and is very generally adopted, viz. to make two steam-engines act on the same axis by means of two cranks at right angles to each other, so that when the one ceases to exert force, the other may he at its point of greatest force.

Thus in the figures 129 to 132 two cranks are represented as coming from two cylinders, and attached to the same axis, so that when the one of them is at 0, the other is at 5, when the first is at 5 the second is at 10, and so on ; so that while either is on the line of cessation of force, the other is at the point of maximum.

The joint effect of two such cranks may be represented by curves in the following way:—

Let the circumference of each crank circle be represented by the lines A X and A 2 X2 as formerly, each semi circumference being divided into eight parts, and let the pressure be calculated from a table of sines, where each will be found as the sine of the arch of the circumference to which it corresponds ; the numbers thus obtained being arranged on the right of the figures, so as to obtain by the two curves the representation of the varying quantity of force, but without regarding the reversion of direction. If now we place these curves together, as in fig. 135, their whole ordinates taken across from the one curve to the other, will truly represent the amount of the sum of the forces and its variation ; and if we place all these ordinates from a fourth axis, we shall have truly represented, by the new curve fig. 136, the variations of the sum of the forces of the two cranks. The figures in the third column represent the sums of the ordinates, in which it is shown that the maximum is 41 per cent greater than the minimum pressure, even when two