threads at the edge of the spot or sprig are lifted again, and the sewing thread put through, then a plain shot of weft, and so on alternately. If the sewing thread is to be shown on both sides of the cloth, then as much of the warp is lifted as will make the extent of the figure, which, in this case, is a quarter of an inch, and the sewing thread is put through below it, then the plain shot of weft is put in; next the sewing thread is put above the same warp threads as it went below before, and so on alternately; this is the principle upon which sewing is done in the looms.

A description will now be given of some of the plans that have been adopted for putting in the sewing thread. In this kind of weaving it has been found advantageous, in almost all instances, to use the Jacquard machine for forming the figures, and for simplicity, it is better to use it alone, allowing both the ground of the cloth and the figures to be made by the Jacquard machine. This plan may cause a little more expense for harness twine and cords, but it is by far the most simple way for the weaver, as he has only to work the one treadle, whereas if a separate mounting were put up for making the ground of the cloth, he would have to work the extra quantity of treadles which that ground may require. The figure having been drawn on design paper, and the extent of the tye fixed on, the cutting of the cards and the mounting of the harness is proceeded with in the same manner as for a full harness, which is explained under "Full Harness;" the only difference being that the ground cards, and those used for the figures, will require to be laced in such a manner that a figuring and a ground card will act upon the needles of the Jacquard machine alternately, so as the warp of the web will be raised to answer both for the ground and the figure when required.

One kind of sewing frame consists of a flat rod of wood placed in front of the top shell of the lay, on which are fixed the small brackets for holding the shuttles with the sewing thread. These brackets are arranged to suit the number of figures which are to be sewed on the breadth of the cloth, and between each bracket a space is left of sufficient extent for the range of the figure. The bracket itself is a little broader than the shuttle is long, but the size of both the shuttle and bracket, and also the space that is between the brackets, depend on the size of the figure to be woven, and also the quantity of figures in the breadth of the cloth. When the weaver has formed the shed for the sewing shuttles, the lay is put back, and the sewing frame depressed so as to allow the small shuttles to be thrown through the shed, from one bracket to another; this is done by shifting another rod endways, which is placed along the top shell, all the shuttles are moved simultaneously, each having a lever attached to the rod. The frame is now raised out from the warp, and the lay brought forward to the fell of the cloth, and the shed made for the ground shot, which is next put in; then the shed for the figure, when the frame is again depressed as before, and the small shuttle thrown back into the brackets they were first moved from, next a ground shot, and so on, a shot for the figure and one for the ground, alternately. If the sewing thread is to appear on both sides of the cloth the same, the small shuttle, after being thrown through the shed and raised up from the warp, is shifted back to the other bracket before the frame is again depressed for the next shot.

Another plan of the sewing frame is, instead of the brackets and small shuttles, to have a number of small copper pieces, about $1\frac{1}{4}$ inch in diameter, and one-eighth of an inch thick, hollow in the centre, and formed like a half-moon, or the letter C; into the inside of the copper circle is put the sewing thread, and the warp threads being also brought up into the inside, or hollow part of the circle, through the opening in its edge, the copper is made to make one revolution, and by doing so, takes the sewing thread under the warp threads. The circles or copper pieces are made to turn by a rack fixed on the top shell of the lay, the teeth of the rack gearing into small pins that project from the sides of the copper pieces. When the weaver is working, he shifts this rack with the same hand as he works the lay, in the same way as a check weaver changes the shuttle box, and with as little trouble; as there is a stopper fixed on the top shell, to prevent it from going too far, either to the one side or the other, but just to allow it to have as much traverse as to turn the circles once round. This plan does not admit of having the sewing thread shown on both sides of the cloth.

There is another method, which in some respects is very like the one first explained. It is superior to any of the others for working spots. When the space between the spots is not more than one inch, instead of a small shuttle being used, as in the first plan, a small brass tube is employed, made in shape similar to a common bottle, the neck of the bottle answering for the eye of the shuttle; the sewing thread is put into the tube at the opposite end of the neck, and then the end closed up, by screwing in a small piece of brass plate. These tubes lie loose on the small brackets, which are depressed into the warp, and are made to roll through the shed, from the one bracket to the other; the brackets are made a little hollow, so as the tubes will not fall off them by the vibration of the lay. By using the tubes, the spots can be shown on both sides of the cloth, if required.

It may be noticed here, that this kind of weaving has not yet been applied to the power-loom with any advantage; and, from the nature of the work, and the low price of hand-loom labour, it is not likely to be a profitable job for the power-loom for a long time to come, unless some plan be invented very different from any of those kinds known at present. All the different movements that are required in this species of weaving can easily be done in the power-loom, but the difficult part is, to get some contrivance which would keep all the small shuttles working properly, and stop the loom the instant that any one of them requires to be refilled with the sewing thread; even this might be accomplished, but then the small quantity that each shuttle holds would cause the loom to be so frequently stopped that it would not pay. However, no one knows what may be done.

CHAPTER VIII.

MOUNTING FOR TWEELS, DIAPERS, &c.

What is meant here by mountings, is the articles or apparatus used for moving the heddle leaves to form the sheds of the web, such as wypers, cams, barrels, rollers, &c.

In Chapter II. a number of draughts are given, and the treading for the same, of different kinds of tweels and diapers. A description will now be given of some of the best mountings for working the heddles, commencing with the three-leaf tweel. If the cloth to be woven is of that nature which does not require the warp to be spread (that is, all the warp threads standing at equal distances from each other), then a common wyper with three arms will do for working the treadles; but if the warp is to be spread, then the wyper requires to be made so as at least one of the heddle leaves will be always down. How to obtain this, and make it understood, it will be requisite to make a few remarks about the speed of the tweeling shaft.

The shaft for a three-leaf tweel makes one revolution for every three picks or shots, or one for three of the top shaft; but the tweeling shafts are in general driven from the under shaft, which makes one revolution for two of the top one, so the wheel and pinion will require to be in the same proportion as two to three. For example, if the pinion on the under shaft has 40 teeth, the wheel on the tweeling shaft will require to have 60 teeth. The proper time for the shed to be full open is the time the top shaft will take to make a half turn. It is explained in the last chapter, how the proper curve is found for cams and wypers, and it has only to be stated here the number of parts that will be required to form the circle of the wyper.

To find the proper form for a wyper of this kind, divide a circle into twelve equal parts of a given diameter, which diameter will depend upon the size of the wyper wanted; four parts of the twelve will be required for each shot (or one revolution of the top shaft), one part to open the shed, two parts to keep it full open, and one part to close it. But for this kind of cloth there is at least always one of the heddle leaves down, and for this purpose the wyper will require to have six parts of the circle for its largest circumference, the other six parts divided into their proper proportions for opening and shutting the shed, and the small circle of the wyper. All the three wypers are made alike, and may be cast in one piece, if thought proper. However, some people prefer having all the three a little different, for the purpose of making the middle leaf rise a little higher than the fore one, and the back leaf a little higher than the mid one; but there is no use for this difference, as the object can be better obtained by the treadles.

The best position for the tweeling shaft is in front of the low shaft of the loom, right below the heddles, and as far off the centre of the loom as will allow the points of the treadles to come fair below the centre of the heddle shafts, where the treadles and heddles are connected. The tweeling shaft will, in this case, be driven by bevel gear.

The top mounting for this three-leaf tweel consists of two rollers, the one above the other; the top one has a wooden or iron pulley on each end, like a cone with two steps, the small diameter of the cone is $1\frac{1}{2}$ inch, the large one is three inches, and it is hung in brackets from the top rail of the loom. On to the small parts of the cone are fixed leather straps, with hooks for hanging the under roller, which is just the same as those used for plain cloth; two of the heddle leaves are hung from the under roller in the usual way, the other leaf is hung by straps which are fixed to the large part of the cone on the upper roller; from the nature of this top mounting, the warp in the heddle leaf, which is lifted, will rise through double the space of what the warp in the sinking leaves will descend. If the shed wanted be three inches when two leaves have been depressed one inch, the other leaf will have risen two inches; so the person who puts the web in the loom will require to take this into consideration when mounting the heddles.

Many other kinds of mountings are used for working three-leaf tweels, which will be taken notice of further on, but the one explained is considered among the best for that kind of cloth which requires to be spread.

MOUNTING FOR A FOUR-LEAF TWEEL.

By referring to No. 5, page 90, the tread of a four-leaf tweel will be seen, and what is said there about it will show how the wypers (we are about to explain) should be placed on the tweeling shaft.

For stout cloth such as sheeting, it is better to use wypers than the common barrel, and they are made on the same principle as the three-leaf wyper, with this difference, that the heddle leaves are allowed to come even every shot. The form of the wyper will be found by dividing a circle into 16 equal parts, and following the directions already given for drawing cams and wypers.

The tweeling shaft with its wypers is placed in the loom, in the same position as that explained for the three-leaf tweel, and is driven by a bevel wheel and pinion in the proportion of one to two, because the tweeling shaft makes only one revolution for four of the top or crank shaft. In the example given for the three leaves, the pinion has 40 teeth and the wheel 60; and if the same pitch of teeth is to be kept in both mountings, then the nearest number that can be got is 33 teeth for the pinion, and 66 for the wheel, which does not come out exactly, the one pair having 99, and the other pair 100 teeth.

The best top mounting for this tweel is three rollers, one of them hung from the top rail in the same way as if it were for plain cloth, with a wood or iron pulley on each end of it. On these pulleys are fixed straps, with small gabs or hooks sewed to their ends, for the purpose of suspending the other two rollers about three inches below the top one. The first and second leaves are hung from one of the suspended rollers, and the third and fourth from the other. Suppose that the heddles are now connected to the four treadles below, the wypers will require to be so arranged on the tweeling shaft that three leaves will be down and one up every shot, in the same order as shown at page 90, under the head "Four-leaf Tweel."

No. 6, page 91, is a different draught for a four-leaf tweel of the same kind as has just now been explained, and to preserve the tweel the same, the wypers are arranged on the shaft so as to produce the treading, as described under No. 6, page 91. The top rollers remain the same for both draughts.

When the cloth of a four-leaf tweel is to have an equal quantity of weft and warp on both sides by sinking two leaves and raising two, in the same manner as described at page 92, only two rollers are required for the top mounting, and they are both hung on brackets from the top rail of the loom. But different wypers will be required for this tweel, as will be evident by referring to the example, and the figure, No. 7, given in page 92.

The four-leaf tweel can be treaded in a variety of ways, and the manufacturer who wishes to have a mounting that will answer for any of them, should adopt that kind of mounting called the barrel and springs.

A very simple barrel for a four-leaf tweel is made by having two cast-iron flanges keyed upon the tweeling shaft, about three or four inches apart; between the flanges are placed a number of pulleys, which act upon the treadles. The quantity of these pulleys used will depend upon the number of leaves that are sunk for one revolution of the tweeling shaft. The pulleys are supported by pins, which extend from one flange to the other, and the pulleys are made as broad that four of them will fill the space that is between the flanges, and their diameter is so large as to allow sufficient traverse for the treadles to form the shed without pressing on the pins. These pulleys can be arranged on the pins to work any tweel that four leaves and four treads will produce. When the workman is placing the pulleys upon the pins to suit the tweel wanted, wherever a pulley is not to be put on, in place of it he puts on the pin a small cut of an iron tube to keep the pulleys in their proper position. For instance, if only one leaf is to be sunk the first tread, only one pulley is put on that pin and three of the iron tubes; if the seeond tread is to sink two leaves, two pulleys are put on and two tubes, and so on—one pulley for each leaf that is to be sunk, and one tube for each leaf that is to rise.

For the top mounting it is always better to use rollers instead of weights or springs, but in some instances it cannot be done, therefore, recourse must be had to some other contrivance for lifting the heddle leaves. With hand-loom weavers it has been a very common practice to employ a complication of levers called marches and jacks for raising the heddle leaves, but for the power-loom this is not necessary; for, by using a small spiral spring for each leaf, for raising the heddles, the whole movements of the heddles are regulated by the tweeling barrel, as the springs will yield whenever any of the treadles are pressed upon by the pulleys in the barrel. Perhaps the using of these marches with the hand-loom weaver is more convenient for him, for by using springs there is always a quantity of power lost in the hand-loom; but it is not so with the power-loom, for if the treadles and barrels are properly made, the power expended upon the extension of the spring is to a certain degree given back in the contraction. The springs can either be applied to the leaves direct, or connected to the ends of levers, and the opposite ends of these levers attached to the heddles. Therefore, the springs make a very simple top mounting for raising the heddles.

DOUBLE BARREL.

If the fabric to be woven requires much power to form the shed, a double barrel is used, one half of it for sinking the leaves, and the other half for raising them. What is meant here by a double barrel, when used for a four-leaf tweel is, one that will work eight treadles instead of four: four treadles to pull the leaves down, and four to pull them up. In this case the flanges that form the sides of the barrel will occupy double the space, so as to have room to hold eight pulleys instead of four, and that part of the barrel which is to raise the leaves must be as far back from the front of the loom as will allow the rising cords to come up at the back of the heddles, to be connected to the levers above, in the same manner as shown at P, P, figure 1, Plate I. But sometimes it is objectionable to have the cords coming up through the yarn, and this is avoided by taking them up at the side of the loom, clear of the warp yarn. This can be done in a variety of ways. One is to have four long marches, with their fulcrum, at one end of the loom, and their points at the other; the points of these long marches being connected with the top levers, and the points of the treadles connected to the centre of the long marches. Another way is to have the points of the four treadles which raise the leaves turned towards the end of the loom, and their fulcrum in the centre of the loom. This does away with the long marches, as the points of the treadles are connected direct to the top levers. When the double barrel is used, the pulleys should be arranged in it from a draught made out on a piece of paper. If the tweel be the same as No. 18, at page 97, and the black squares the sinking leaves, the white squares must be the rising ones; so the pulleys must be placed in the barrel to correspond to the design paper.

The barrels made with pulleys and flanges on the plan just now explained, although easily made, are not nearly so good as some of the other kinds which will require to be described, for working the larger tweels, diapers, double cloth, &c.

MOUNTING FOR A FIVE-LEAF TWEEL.

For illustration, take No. 8, in page 93, and although it is the general rule in treading a web to sink the greatest number of leaves, and raise the fewest, in this case we will reverse it, for the purpose of having an opportunity of explaining a simple plan of a barrel. In the figure, No. 8, it will be seen that there is one black square and four white ones, which represent the five leaves; the black are those that are to be sunk, and the white those that are to be lifted. If the tweeling shaft be placed in the loom, in the same way as it is for the three-leaf tweel, the pinion for driving it will require to have two teeth for every five that is in the wheel; if the wheel has 70 teeth, the pinion will require to have 28, the two added together making 98, which number makes the nearest approach to the same pitch as the three and four-leaf tweels.

As only one leaf is to be taken down at a time, all that is necessary to put on the tweeling shaft is a small projection for each treadle, arranged on the shaft in the form of a scroll, in such a manner as the one follows the other in regular succession, which projections depress the treadles. The top mounting being made with springs, all the leaves will be held up, except the one that is taken down with the treadle, that is depressed by the barrel; and to prevent the leaves from rising any farther than what is necessary to form the shed, an iron guide is placed above the points of the treadles for that purpose, which can be set to give the size of shed wanted.

When a different treading is required for a five-leaf tweel from that just now explained, another kind of barrel is employed; and one of the best kinds is made up of five flanges or plates (called "stars" in the trade), all the five being alike, only one pattern is made, which is drawn in the following manner:—

Before beginning to draw the form of the star, the size of the shed, the length of the treadles, and the part of the treadle where the barrel is to act upon, must be understood. The space that the points of the treadles traverse will determine the size of the shed. Suppose that to be $3\frac{1}{2}$ inches, which will be sufficient for an ordinary web, making allowance for the eye of the heddles and the stretch of the cords; say the length of the treadle is 24 inches, and the part of the treadle that is acted upon by the barrel to be 8 inches from the fulcrum or heel, from these figures (by the rule of proportion) will be found the traverse of the treadle at the barrel, which will determine the throw of the star.

If 24 inches give $3\frac{1}{2}$, what will 8 give?

EXAMPLE.

24 : $3\frac{1}{2}$: : 8
8

24
4

24)28($1\frac{1}{6}$
24

4

24

The diameter of a barrel for 5 leaves, with its tapets in, need not be more than 10 inches, so a circle is first drawn 10 inches in diameter, then another $9\frac{5}{12}$ inches in diameter, also another $8\frac{5}{8}$ inches; after this is done divide the 10 inch circle into 20 equal parts, with a pair of dividers, and from each mark made by the dividers, draw a radius line to the centre of the circle; this will give four parts for each tread, one to open the shed, two for keeping the shed open, and one to close it. The two parts for keeping the shed open will be part of the circle, which is 10 inches in diameter; the other two parts will be a curve made from the 10 inch circle to the $9\frac{5}{12}$ inch one. From the $9\frac{5}{12}$ inch circle, to the circle which is $8\frac{5}{8}$ inches in diameter, will form another curve of one part, the next two parts have the circle of $8\frac{5}{8}$ inches, so that there will be a curve made from the 10 inch circle, which will make a uniform motion for the movement of the heddles from the $8\frac{5}{8}$ circle to the 10 inch one. When all these lines are drawn upon the piece of wood that the pattern is to be made from, the form of the tapet will be got from the marks made above the line, which is $9\frac{5}{12}$ inches in diameter, and after it is got the workman begins to make the pattern for the star, by cutting away all the wood that is above, making it exactly $9\frac{5}{12}$ inches in diameter, and then cutting it out by the marks down to the circle which was drawn $8\frac{5}{8}$ inches in diameter. When this is done the star is formed, so far as its circumference is concerned.

Into each of the five divisions on the star, there is made a recess for the tail of the tapets to go into, and the five bolts that hold the stars together, also serve for keeping the tapets in their places, therefore the bolt holes require to be cast in the centre of this recess.

When the stars are all cast, and ready for forming the barrel, they are placed on the tweeling shaft, and screwed close up to the back of the bevel wheel with the bolts. In general there is a ring cast on the back of the bevel wheel for the purpose of screwing the stars to. When putting the tapets into the barrel, the workman is provided with a piece of paper with the draught of the tweel upon it, and from this paper he sees where they should be put in, or left out; only one bolt is taken out at a time, for if all the five bolts were made loose at once, the stars would be liable to get out of position.

By using a tweeling barrel made with the stars and tapets, along with the springs for the top mounting, it has the following advantages over the one previously explained:—First, the tapets can be arranged to answer any tweel that comes within the range of five leaves and five treads; and second, the heddles meet in a mid position every shot, consequently, the shed is made by the heddles rising to form the top shed, an equal distance to those that sink to form the under one; thus keeping an equal strain upon the yarn in both, which cannot be accomplished by the other barrel with any degree of accuracy.

TWEELING TREADLES.

The treadles for this kind of barrel should be made of cast iron, and the small pulleys in them that are acted upon by the tapets, should be set a little lower than the point and heel of the treadle. This can be done by making the treadle the form of a bow, instead of it being straight.

Before going on to explain the mountings for the larger tweels and diapers, a description of the treadles that are generally used for diapers and large tweels is deemed requisite in this place, which will save any further remarks about them when explaining the different barrels.

For some kinds of work it is not convenient to use the brander for guiding the points of the treadles, and if the brander be done away with, some other mechanical contrivance must be substituted for keeping the treadles in their proper place. One of the plans employed for that purpose is to have the two outside treadles with long bearings at the treadle heel pin, and the inside of the outside treadles made broad and flat for about five or six inches at the heel; the centre treadles being made in the same way, except that their bearings are no longer than the thickness of the treadle; in this way the treadles are kept from moving either to the one side or the other if they are properly fitted. Instead of having the flat part of the treadles the six inches all to the front of the heel, it is better to have three inches to the front and three to the back of the heel, if there is room for this way in the loom. When no brander is used in front of the barrel, the workman gets easier at the points of the treadles to adjust the sheds, and to get this advantage, some make the treadles to project away back from the heel a sufficient distance, so as to employ a brander at the back of the barrel.

Sometimes the treadles (or rather levers when used in this way) are placed above the barrel, with their fulcrum at or near their centre. The one end of the lever is made to come to the centre of the loom, right below the heddles, where the heddles and levers are connected; the other end to be fair above the centre of the barrel, and on this end is fixed the pulley for the tapets to act upon. As the barrel revolves, the tapets cause that end of the lever to ascend, which is in contact with the barrel, the other end descends; and being connected to the heddles, pulls them down to form the shed. That end of the lever which is connected to the heddles, will describe part of a circle when moving, which will cause the heddles to move a little endways; and to prevent this, a small segment is cast on the end of the lever for the cord to work upon, which connects the heddles to the levers. These levers have movable fulcrums, which can be shifted at pleasure to suit the size of the shed. They are supported by two castings, which are bolted to the framing for holding the barrel; and as the levers must always be in the position that their ends will answer for the barrel and heddles, the two castings which support them require to be shifted along with the fulcrums of the levers.

Another way to use the lever above the barrel, is to have two sets of them, and the barrel placed in the centre of the loom; each pair of levers is connected with a joint right above the centre of the barrel, and their opposite ends to the heddles. This plan is better adapted for heavy work, because the heddle shafts can be corded at two different points; whereas, in the other way, the heddle shafts are only caught in the centre with the under cords, unless small jacks be used.

These levers are sometimes employed with the barrel placed outside the loom, at the opposite end from the driving pulleys, and in this case one set is put above the heddles, and another set below them; so arranged that one end of the lever will come to the centre of the loom, and their other end to the barrel; and their fulcrum is at or near their centre, which is made movable like the others; but in this case there is a set of treadles used along with the levers, and the points of the treadles are connected with cords to the top and bottom levers. This kind of mounting was at one time extensively used for weaving that class of goods called moleskins and corduroys.

MOUNTING FOR A SIX-LEAF TWEEL.

A barrel can be made for working a tweel with six leaves from the same rules which have been given for making the five-leaf barrel, and by adding one division more to the star, and one star more to the barrel, that will make the barrel to contain six stars, and each star will have six divisions. What is meant here by the word "division," is that part on the circumference of the star, which is required to make one tread. It is common for tradesmen to say, when speaking of tweeling barrels, it is a barrel for "so many leaves, with so many treads;" for instance, if only three of these stars were put on a tweeling shaft, it would be called a barrel for three leaves, with six treads, &c.; for every star that is put on the tweeling shaft, one leaf more, and for every division in the star, one tread more; and it is plain that if stars are put on, with six divisions to make the barrel, it could work a three-leaf tweel by repeating the treading for it twice on the barrel.

No. 10, at page 93, will show how the tapets are arranged on the barrel for a regular tweel, and No. 11

for a broken one. The top mounting for this tweel can be made with the springs, as already explained.

This barrel will make one revolution for six picks, and if driven off the under shaft the same as the others, the pinion will be as one to three of the wheel; and if the same pitch of teeth is still to be preserved, the pinion will have 25 teeth, and the wheel 75, which is 100 for both, making the pitch exactly the same as the three-leaf tweel. It will be readily understood how the treadles are made and placed from what has been said before.

MOUNTING FOR A SEVEN-LEAF TWEEL.

A barrel is made for this one by putting on seven stars, each star with seven treads, and the tapets put into their places in the same order as shown by No. 12, at page 94; No. 13 is the broken tweel; the pinion for this one will be in the same proportion as two to seven of the wheel, the pinion having 22 teeth, and the wheel 77, making 99 in both. The top mounting and treadles for this tweel may be the same as the others.

To find the proper proportion for the number of teeth in the wheel and pinion for driving the barrels for these simple tweels,—First ascertain the number of treads the barrel will make in one revolution, then fix a number that will divide by the number of treads, and divide the number fixed upon by the number of treads; and if the barrel be driven off the under shaft, which makes one revolution for two shots or picks, multiply the dividend by two, which will give the number of teeth for the pinion.

For illustration, take the seven-leaf tweel. The barrel makes seven treads for one revolution, and the number of teeth fixed upon is 77, because that number will divide by the number of treads—viz., seven, and the number of times that seven can be got from 77 is 11; so 11 multiplied by two, makes 22, the number of teeth in the pinion.

EXAMPLE.

```
7 | 77
    11
     2
    --
    22   Number of teeth in pinion.
```

Again,—Suppose an eight-leaf tweel with eight treads, and the number of teeth fixed upon to be 96; then 96 divided by eight (the number of treads) will give 12, and 12 multiplied by two will give 24, which is the number of teeth for the pinion required.

EXAMPLE.

```
8 | 96
    12
     2
    --
    24   Teeth for the pinion.
```

But if the same pitch of teeth be kept for the eight leaves as for the others, then the number of teeth for the wheel must be 80, and 80 divided by eight gives 10, and 10 multiplied by two gives 20, the number of teeth for the pinion.

EXAMPLE.

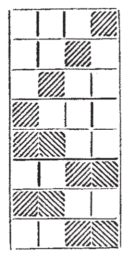
$$\begin{array}{r|l} 8 & \underline{80} \\ & 10 \\ & \underline{\ \ 2} \\ & 20 \end{array}$$ Teeth for the pinion.

MOUNTING FOR AN EIGHT-LEAF TWEEL.

A barrel for working eight leaves is made with eight stars, each star having eight treads. The wheel and pinion for driving this barrel is already given, and the arrangement for the tapets for a regular and broken tweel will be seen at page 95. It will be evident, from what is stated under "Six-leaf Tweel," that a four-leaf tweel can be woven with this barrel by putting in the tapets, as shown at No. 6, page 91, for a regular tweel. It will also do for No. 18, shown at page 97; in both cases the tweel will require to be repeated two times on the barrel. This mounting will also work four shots of plain, and four shots of tweel alternately, by arranging the tapets, as shown in No. 51, on four of the stars, and keeping the draught the same as No. 6.

FOUR SHOTS OF TWEEL AND PLAIN, ALTERNATELY.

No. 51.

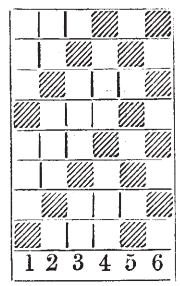


At one time the demand for this kind of cloth was very great, which caused some of the power-loom weavers to turn their attention to it, and the result was that many different plans were adopted for working plain and tweel stripes. When the tweel stripe is to be made thicker than the plain one, it is necessary to have an apparatus to make the cloth beam move slower when the tweel stripe is working, which need not be explained in this place.

This barrel can also be made to work plain and tweel stripes in the warp, by employing six leaves; four for the tweel, and two for the plain, the tapets being arranged in the barrel as shown at No. 52.

PLAIN AND TWEEL STRIPES IN THE WARP.

No. 52.

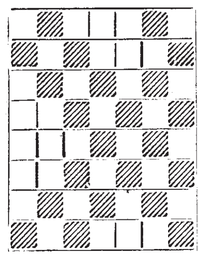


The figures 1, 2, 3, and 4, represent the tweeling leaves, and 5 and 6 the plain ones. The size and variety of these stripes depend upon taste, but the tweeling stripes should always have as many threads as will make a full draught, which is four, so that the tweel stripes will require to be 4, 8, 12, 16, or any other number that will divide by 4.

DIAPER AND PLAIN CLOTH.

By turning to page 102, it will be seen that the five-leaf diaper, No. 26, can be woven by this mounting. No. 28 and No. 29, in pages 102 and 103, No. 31, in page 104, and No. 32, in page 104, come all within the range of this barrel. If plain cloth is to be woven along with any of these diapers, all that is required is to put in other two leaves, which will make seven—two for the plain and five for the diaper, as shown at No. 53; the diaper part of it is the same as No. 28.

No. 53.



This shows the principle upon which plain and diaper stripes are woven.

MOUNTING FOR A TEN-LEAF TWEEL.

The barrel for this mounting requires ten stars, and each star 10 treads. The number of teeth for the wheel and pinion will be found by the rule given under "Mounting for a Seven-Leaf Tweel." No. 21, at page 98, gives one arrangement for the tapets; and some of the other kinds of cloth that can be woven by this barrel will appear further on.

MOUNTING FOR A TWELVE-LEAF TWEEL.

When a tweel requires more than ten leaves to work it, the heddle shafts are in general made much thinner, for the purpose of taking up less space in the loom. If the ordinary shafts that are used for a four-leaf tweel (each shaft five-eighths of an inch thick) were taken for a twelve, the space they would occupy would be nine inches, that is allowing one-eighth of an inch of clearance for each leaf. To make this space less, the heddle shafts are made as thin as the nature of the cloth will admit of, and if the shafts are made to take up less space, the barrel must be made to correspond to the heddles. But it is found in practice a very difficult thing to keep each respective treadle working properly with its respective star, if the stars that compose the barrel be as thin as the heddle shafts which are employed for large tweels; and to avoid this difficulty, the points of the treadles are contracted. The star should not be made thinner than five-eighths of an inch, and twelve will occupy a space of 7½ inches. If the heddles are made to work in the space of five inches, the points of the treadles must be made to work in five inches also; and the way to manage this is to make twelve different patterns for the treadles. The two treadles for the centre of the barrel are made almost straight, the point of the one bent a little towards the left hand, and the point of the other a little towards the right. The next two treadles are bent in the same manner, having a little more bend than the first two, and so on, with each pair of treadles, over all the twelve; giving each treadle a little more bend than the one next it, so that the difference between the space occupied by the points of the treadles from what they occupy at the barrel, will be 2½ inches.

Before commencing to make the patterns for treadles of this kind, a ground plan of them and the barrel should be drawn the full size, showing the space that each treadle will occupy, and from this drawing the exact bend of each treadle will be seen; it will also show the exact thickness for the brander blades.

The driving of this barrel is different from those previously explained, on account of its size in circumference, it making only one revolution for 12 picks. Like the others, it has one star for each leaf, each star having 12 treads; and if it were driven in the same way, the wheel would be so large that it would be inconvenient to have the barrel placed in the loom to answer the heddles; and in order to have it placed in the position most suitable for the heddles to be corded in the same manner as the others, the following alterations are made:—Instead of the stars being bolted to a bevel wheel, they are bolted to a spur one on the opposite end of the tweeling shaft, so as to allow the barrel to get close to the under shaft of the loom; this is necessary, in consequence of the bends that are made in the treadles. This spur wheel is driven by a pinion which is keyed upon the end of a small shaft that revolves in front of the barrel; and this small shaft has a bevel wheel on its other end, which is driven by a bevel pinion that is on the under shaft of the loom. If the small shaft in front of the barrel makes one revolution for six picks, the bevel pinion will be in the proportion of one to three of the wheel, and the spur pinion as one to two of the spur wheel.

Some of the barrels we have yet to explain are driven in the same way as this one for the twelve leaves, and the same pattern for the spur wheel may do for a number of them, if the number of teeth be fixed at 120; and although the stars be of different diameters for the different barrels, the ring on the spur wheel may be made to answer the different sizes of stars. Let the bevel pinion on the under shaft have 20 teeth, and the bevel wheel 60, and the proper speed to the twelve-leaf barrel will be given by putting a spur pinion of 60 teeth on the end of the small shaft which works in front of the barrel.

TOP MOUNTING FOR LARGE TWEELS.

The top mounting for tweels with more than ten leaves requires a different arrangement from those of a less number, and one of the best kinds can be fitted up in the following manner:—

Have two cast-iron rails in place of one for the heddle-bearer or top rail; let them be fitted up so that the space between the two will be exactly the same as the space occupied by the heddles. At that side of the loom where the springs are to be placed, have a small bracket bolted to the upright for holding them by the ends. The springs are so arranged in this bracket, that they will all be clear of each other when working; the other ends of the springs are attached with wires or cords to the levers above, which levers work between the two top rails; the thickness of the levers will depend upon the size of the heddle shafts that are used. To prevent the springs from being too much stretched, the levers are made with their fulcrums near to the end where the springs are attached. For medium cloth, if the shed be three inches, the springs may be made to yield $1\frac{1}{2}$ inch.

When the web is narrow, one set of levers will do for lifting the heddles; but if the web be a broad one, it is better to use two sets; and when that is the case, the first set, or those that the springs act upon, have an extra arm cast on them right above their fulcrum. The other set is made in the form of a bell crank, and the two sets are connected with wires, so that both are acted upon by the springs simultaneously.

The levers being hung upon pins which pass through the top rails, they are not likely to get out of order, as these rails keep them in their place when once properly fitted. The only objection to the employment of levers for lifting the heddles is, that they do not move up and down perfectly perpendicular; but that objection can be entirely removed, as stated before, by having the ends of the levers properly made; when so made, this top mounting will be found more simple to work, and take less power to work it, than those that are fitted up with the small pulleys and cords.

No. 22, at page 98, shows the arrangement of the tapets for a twelve-leaf fancy tweel; and any other tweel, either regular or broken, that comes within the compass of twelve leaves and twelve treads, can be woven by the barrel and top mounting we have just been describing; it is also suitable for working a number of the diaper patterns.

MOUNTING FOR A SIXTEEN-LEAF TWEEL.

The barrel and top mounting for this tweel can be made exactly on the same plan as the one for the twelve leaves; but of course will require sixteen stars, each star with sixteen treads. The driving gear will also be on the same principle as that described for twelve leaves, and the same bevel wheel and pinion will do; also the spur wheel for the barrel; but the spur pinion on the end of the small shaft, in front of the barrel, will require only 45 teeth, instead of 60, which is the number of teeth in the other.

To find the number of teeth that is required in the pinion for driving this barrel, first divide the number of teeth in the spur wheel, which is 120, by the number of treads, which is 16; then multiply the product by the number of picks the loom makes for one revolution of the small shaft, which is six, and the answer is the number of teeth for the pinion.

EXAMPLE.

```
16)120(7½ × 6=45   Number of teeth for the pinion.
   112
   ---
     8
   ---
    16
```

Another way is to multiply the number of teeth in the barrel wheel by the picks made during one revolution of the pinion, and divide by the number of picks made during one revolution of the barrel; in this way there is no fraction.

EXAMPLE.

```
     120
       6
  -------
  16)720(45
      64
     ---
      80
      80
```

No. 23, at page 99, shows the arrangement of the tapets, for what is called a full satin tweel. It is seldom used, except for very fine goods, and then it is used along with a harness for the ground of the cloth.

MOUNTING FOR DIAPERS.

Those mountings that consist of the barrel formed with stars, and the springs for raising the heddles, which have been described for tweeling, will do for a number of the diapers; and it will only be necessary to state the different barrels that are suitable for diapers, as we proceed, beginning with the three-leaf diaper.

MOUNTING FOR THREE-LEAF DIAPERS.

It will be seen at page 100, No. 24, B, how a three-leaf diaper is treaded; and that it requires six treads to complete the pattern, so that either the barrel for the six-leaf tweel, or that for the twelve will do for it. In each barrel only three of the treadles are used, but the barrel for the twelve leaves will require to have the pattern repeated twice upon it. If the web be finer than a 10^{00}, six leaves of heddles should be used, each pair can be fixed as one, and attached to one treadle. This keeps the heddles from being too crowded upon the shafts, and makes it easier on the warp.

MOUNTING FOR A FOUR-LEAF DIAPER.

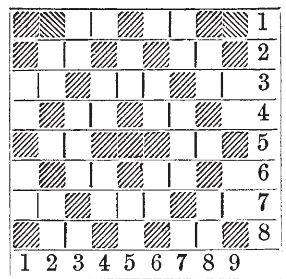
A four-leaf diaper can be woven with the same two barrels that have been pointed out for the three, because it only requires six treads for the pattern, which will be seen by turning up No. 25, at page 101.

MOUNTING FOR FIVE-LEAF DIAPERS.

The barrel which works an eight-leaf tweel will do for any diaper with five leaves, when they have not more than eight treads for the pattern, such as No. 26, at page 102, and Nos. 28 and 29, at pages 102 and 103; also No. 31, at page 104, and No. 32, at page 104. All these and many more can be woven with the same barrel, by arranging the tapets to suit the pattern.

If any other pattern be wanted which can be woven with five leaves and eight treads, all that requires to be done, is to draw the pattern wanted on design paper, the full size, and from it will be seen how the tapets should be arranged in the barrel. For illustration, we will draw No. 26 full size, to show how the arrangements for the tapets are got. The part of the pattern, No. 54, which is taken for the arrangement of the tapets in the barrel, is that part right above the figures, 5, 6, 7, 8 and 9, it being a diamond draught; the other part does not require to be taken.

No. 54.



In drawing small diaper figures, it is better to draw on the design paper two or three repeats of the pattern, so as to prevent any blunder being made in the cloth where the figures join.

MOUNTING FOR A SIX-LEAF DIAPER.

The barrel taken notice of for a ten-leaf tweel will do for any diaper with six leaves and ten treads; consequently, it will answer for No. 33, in page 105, also Nos. 34, 35 and 36, in pages 105 and 106, and Nos. 37 and 38, in page 106, by arranging the tapets to suit the different patterns, as shown by the respective drawings under their numbers.

MOUNTING FOR A SEVEN-LEAF DIAPER.

No. 39, at page 107, is a seven-leaf diaper, with twelve treads, so that the barrel for working the twelve-leaf tweel will also suit to work this diaper by arranging the tapets to answer the pattern; and, although only one pattern is given for the seven leaves with twelve treads, many more can be woven with the same number of leaves and treads, as will be readily understood from what has been previously stated under "Mounting for Five-Leaf Diapers."

MOUNTING FOR EIGHT-LEAF DIAPERS.

Nos. 40, 41, 42 and 43, at pages 107, 108 and 109, show the treading or arrangement of the tapets for four different kinds of eight-leaf diapers with 14 treads. The barrel for working these patterns is made upon the same principle as the barrel for working the twelve-leaf tweel, the only difference being that eight stars will do, and that each star will require to have 14 treads. It will be evident that none of the mountings previously explained will answer for these diapers, because of them having 14 treads; therefore, the small shaft that works in front of the barrel will require to make one revolution for $5\frac{1}{4}$ picks, and that speed can be got for it, by putting a bevel pinion on the under shaft, with 16 teeth, to drive a bevel wheel on the end of the small shaft, which will require to have 45 teeth. The spur wheel and pinion used for the sixteen-leaf tweel will do for this diaper, namely, 120 teeth for the wheel, and 45 for the pinion.

EXAMPLE.

```
    120
     5¼
  ———————
    600
     30
  ———————
14)630(45   Teeth on the pinion.
   56
  ———————
    70
    70
   ————
```

MOUNTING FOR A TEN-LEAF DIAPER, WITH THIRTY-SIX TREADS.

When a pattern requires more than 16 leaves and 36 treads, it is not advantageous to use the barrel, although barrels have been made to work as many treads as 96, and its diameter was not more than 32 inches; however, the barrel mounting does very well for 63 treads.

The spur wheel with the 120 teeth will also do for this barrel, and the shaft in front of it, to make one revolution for six picks; the spur pinion will require to have only 20 teeth, which will be seen from the calculation.

EXAMPLE.

```
    120
      6
  ———————
36)720(20   Teeth on the pinion.
   72
  ————
    00
```

When any fabric requires a large number of treads to complete a pattern, and that pattern can be made with less than 20 leaves, it is sometimes found cheaper not to employ a harness, but some of the other plans which have been adopted for working heddles. Some of these plans will be taken notice of in this place.

There is one plan for working the heddle leaves with what is called a skeleton Jacquard machine, placed above the loom, in the same way as shown at Figure 6, Plate III. For each leaf that is to be employed, there is an upright wire put in the machine, in the same manner as in the common Jacquard machine, and to this wire is hung the heddle leaf; and, suppose that 20 leaves are to be used, then 20 of these wires are put in the machine; they can be lifted with a single brander blade, but it is better to have two rows of wires, with ten in each, and two brander blades, which will take less space and material.

The heddle leaves can be taken down, either with springs or weights, and they are raised by the small Jacquard machine, in the same way, and by the same appliance, as described for the full harness in page 196. In this way the warp yarn will be lifted from the race of the lay to form the shed, which is in some respects an objection; and to obviate that objection, some of these machines are made so as the leaves that form the under shed will sink as far as the others rise to form the top one; this is done by allowing the under-board of the machine, where the needles rest upon, to descend when the brander that lifts the needles is in the act of rising. To accomplish this movement, instead of using one lever, as shown at Figure 1, Plate I., there is another put below it, which is made to descend by the motion of the top one ascending. By using this kind of machine it is thought the shedding is easier on the warp yarn, but it will be evident that it is not so simple as the other.

Like all the other mountings for figured work, the pattern has first to be drawn upon design paper; and if the pattern is to be regulated by cards, the holes are punched in them to answer to the drawing, just in the same manner as setting the tapets in the barrel. Sometimes, instead of cards, small slips of wood are used, with pegs fixed upon them, to act upon the needles of the Jacquard machine, and these pegs are arranged on the slips of wood to suit the pattern that is to be woven.

Another plan is to have the small Jacquard machine placed at the side of the loom, which has the advantage of being got at with less trouble when changing the pattern. There are many modifications for working the heddle leaves by the barrel and Jacquard machine placed at the side of the loom, and a description of one of the best will be sufficient to lead to a knowledge of the others.

For illustration, suppose the number of leaves in the web to be 20, then place above the heddles 20 sets of levers in the same manner as those explained for diapers; also 20 sets below the heddles, and to the ends of these levers, that project over the side of the loom, there is attached a rod with a hook or catch to each of them. This gives 20 for raising the heddles, and 20 for sinking them. Each heddle leaf is connected to a lever above and one below; and the lifting and sinking of the leaves of heddles is by means of two iron bars, which rise and fall to form the shed. The fulcrum of the iron bars is placed at front of the loom, right below the lay, in a line with the fell of the cloth; by having them placed in that position, each heddle leaf forms a shed larger than the one immediately before it, without any alteration in the cording being made for that purpose.

The hooked rods that are attached to the levers are made to take hold of the iron bars by means of springs, and at the point of action, before the bars begin to move from each other, the barrel or card puts out of gear the hooks that are not to be employed to raise or sink the leaves. The bars receive their motion from a cam or wyper, which is made to give the proper size of shed. It will be obvious that any length of pattern can be made by this mounting, if cards are used, but they must be all of the diced or draught-board pattern. This mounting is also well adapted for an index for the patterns of check work, where more shuttles than one are used. Instead of cards or the common round barrel being employed to make the pattern, some use an endless chain, which is made to revolve on two small drums, the drums being made with notches to correspond to the links of the chain.

When cards of a similar kind to those used for the common Jacquard machine are employed for the skeleton machine, it is better to get them made of thin iron, when the pattern is one of those that is not likely to go soon out of fashion, as they will last much longer than the paste-board ones.

NEW IMPROVED SHEDDING MECHANISM.

We have given a description of various apparatuses for moving the heddle leaves, or what is known in the trade by shedding. It is there explained how different barrels can be made for the different tweels and small diaper patterns for taking the leaves down, and it is also stated how top mountings can be made for raising the heddle leaves. It is also explained how the heddle leaves are worked with two levers and a small barrel with cards, and that apparatus moves the heddles up and down without the use of springs or weights for taking down the heddle leaves.

Mr. Muir (of William Muir & Company), manufacturers, Tobago Street, Glasgow, showed me a new improved shedding apparatus which he had started, and at the time I saw it working, it was doing its work splendidly. The apparatus is at the side of the loom, instead of being on the top of it like the Dobie machine. The index is an octagon barrel with cards, and acts in the same manner as the Jacquard or Dobie machine upon horizontal needles, and these needles act upon hooked rods that hang perpendicular. Upon the end of the crank shaft is fixed a small bracket with a friction roller upon it, and that friction roller works into a curved bracket which moves the levers for forming the shed. The curve in the bracket is so made that it gives the proper rest for the heddle leaves at the time the shuttle is being driven through the shed. He has two levers placed at the lower end of the hooked rods. One of these levers is used for raising the heddle leaves. Each hooked rod is attached to a couper, and, according to the pattern, the descending lever pulls the heddle leaves up; the other lever is for the purpose of allowing the leaves that are raised to go down and to bring them back again to their mid position, when the leaves are again ready for a change of action. The advantageousness of this apparatus, is it being placed at the side of the loom where it is got at by the weaver with the least possible trouble. The barrel for moving the cards is quite convenient for the worker's hand, and any oil or dirt falling from the working parts of the apparatus does not go on the web. The barrel for the cards is taken back by a small cam which is fixed on the end of the top shaft, and it is brought forward to the needles with a spiral spring, which is an improvement upon the positive motion for working the barrel; because, when any obstruction takes place to prevent the barrel from coming forward, the spring yields, and no damage is done to the cards or barrel; and by using the wyper for taking the barrel back, the movement of the cards can be regulated to any degree of nicety. The heddle leaves are taken down by springs in the usual way. Taking the apparatus as a whole, it is very well got up, and will be very suitable both for heavy and light fabrics.

Mr. Muir has been upwards of forty years connected with the power-loom trade, and this improvement he has made on the power-loom is not the only one he has invented. He has been improving the check power-loom by a number of his inventions for the last twelve or fourteen years, and has seen the present power-loom rise by degrees from its original state, with its one shuttle and two treadles, with two heddle leaves, and working at the rate of sixty-five picks per minute.

ANOTHER SHEDDING MECHANISM.

A perfect shedding apparatus has not yet been made, but as far as our present knowledge goes its requirements would be as follows:—It should be so constructed that it will work any quantity of heddle leaves, and it should be able to move the leaves up or down in every imaginable way, so that it will work any figure that can be woven with heddle leaves. It should have no springs for taking the leaves up or down, because springs, as they are at present used with the Dobie machine, take a considerable amount of power to work them, and the greatest power that is required to move the springs happens just at the time when it should give the least resistance to the movement of the heddle leaves. Of course by using weights that fault of the springs will be obviated. But weights have their faults also, so that which is needed is a motion that will take the leaves up or down without either springs or weights, in the same manner as it is done in weaving plain cloth. The sheds should have the same rest as what they have in the weaving of plain cloth, and the rest capable of being altered to less or more to suit the fabric that is to be woven.

To have a large range of pattern some such pattern mechanism as the barrel, with cards, similar to the Jacquard machine, should be employed, and the barrel should not be taken forward to the needles by a positive motion, but by something that will have force enough to bring it forward, but not so strong as to do any damage if there is any thing to obstruct its progress towards the needles. This is done, as before explained, by a spring, in the apparatus that has been started by

Mr. Muir (of William Muir & Company), Tobago Street, Glasgow, and it should be taken back by a cam (or wyper) made to give the proper motion for the cards, and the proper rest for the needles, if it is the barrel and cards that are used for making the pattern.

It also should be made so as all the heddle leaves will come even every shot, and the twine that the heddles are made with should always have the same amount of tension, which is not the case when the leaves are taken up or down by springs. When the heddles are kept at a uniform tightness, they last much longer, and are easier on the warp yarns; and as the worker has frequent occasion to turn the cards back or forward to find the proper shot of the pattern, the barrel should be in the most convenient place for the weaver to get at it, and free to turn by the weaver's hand, without disturbing the position that the loom may be standing in at the time.

A shedding apparatus with all the foregoing requirements will be very nearly perfect, and one is being made just now with the intention of accomplishing them, but as it has not yet been made known to the trade, in any of its details, it would at present be premature to describe it.

A JACQUARD WITHOUT CARDS.

To weave any kind of diced work, a very simple machine may be employed. As we have explained the Dobie machine, and how it works, in another place, no further notice need be taken of it here, except that the same plan that we are about to describe, can be applied to the Dobie machine as well as the Jacquard machine.

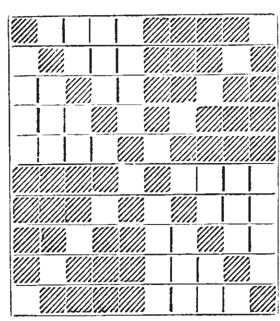
For illustration, take a Jacquard machine with 64 needles all in one row. The harness may be tied to represent that number of heddle leaves, or may stand to represent 32, 16, 8 or 4 leaves. We will take for example a four-leaf tweel that is to be woven, and that the barrel of the Jacquard machine has four sides, with four rows of holes in each side of the barrel, and that the machine needles are opposite the row of holes that are made in the top edge of the barrel. It will be evident that when the barrel is brought forward to the machine, all the needles will enter the holes that are in the barrel. Now, suppose that each alternate hole be plugged up with a piece of wood, or some other substance, and again to be brought forward to the machine, each alternate needle will be pressed back; and by lifting the brander off the machine, a plain shed would be formed. Take the next side of the barrel, and plug up the other half of the holes in the top row to correspond to those that were left unfilled on the other side, and when brought forward, this will form the other plain shed. The other two sides of the barrel being filled in the same way, and the loom set to work, would make plain cloth, by the barrel being turned in the common way.

By moving the barrel in its frame about three-eighths of an inch up, or a distance equal to the distance between the rows of holes in the barrel, the second row (we will call the top row the first) of holes will come to be opposite to the needles in the Jacquard machine. And if the holes be plugged up to answer a tweel with three threads up and one down, it will follow that as long as the barrel is kept working in this position, it will weave the three and one-leaf tweel. Suppose the first had been kept working until it had woven two inches of cloth, and the second row until it had woven two inches of cloth, and then shifted up to the third row of holes in the barrel, and the third row of holes plugged to answer a tweel with one thread up and three down, and kept working to make two inches of cloth; then you would have two inches of plain cloth, and two inches of each of the tweels. And if the second and third rows be kept working alternately, so that each row makes two inches of cloth that would form a draught-board pattern, with squares of two inches square, if the web were drawn for that purpose; but if not, it would weave two inches of tweeled cloth the whole breadth of the web. But it will be seen, that by the barrel having four rows of holes, four different tweels can be woven at the same time, or three different tweels and plain cloth; and by using a barrel with eight rows of holes in it, a much greater variety could be produced with it, and still have no cards.

DICED WORK.

Many different kinds of patterns can be made with heddle leaves, which come under this heading. The principal thing to be attended to is drawing the warp into the heddles. The most simple pattern is what is called the draught-board; a sketch of it on the smallest scale is given at No. 55. It will be seen that the pattern is made by reversing the tweel, and although

No. 55.



the draught is given only once over, any size of pattern can be made that the web can admit of, the whole depending upon how the web is drawn. No. 55 is a five-leaf regular tweel, but in most kinds of cloth the broken tweel will answer best; however, this will show how the patterns are made. If the web to be woven be 36 inches wide, and the tweel a five-leaf one, then ten leaves are required, and they are made spaced to suit the pattern; otherwise, the heddles must be set to answer it. The web being 36 inches wide, the largest pattern that can be woven on it of the draught-board kind is 18 inches, and the smallest five threads, which is once over the draught; but any intermediate size of pattern between the five threads and 18 inches, can be made, provided that the pattern fixed upon will repeat a given number of times in the breadth of the web.

By employing fifteen leaves of heddles, which would make three sets for a five-leaf tweel, the opportunity of making a larger variety of patterns is greatly increased, and some very complicated things can be done, but they have always that stiff appearance which is unavoidable in figures made by heddles. There is nothing yet so good as the full harness for making neat figures on cloth, and the only thing that keeps it from being generally employed, is the expense that it takes to make large patterns with it.

DOUBLE CLOTH MOUNTING.

What is meant here by "double cloth," is the combination of two warps with their wefts. For some kinds a very simple mounting can do for them, but for other kinds they require a harness.

The principle upon which double cloth is made is as follows:—If the fabric is to be of a plain texture, four leaves of heddles will do, two for the one warp and two for the other. Although two warps are named here for the sake of distinction, the whole warp yarn may be put on one beam, when both sides of the cloth are to be made the same.

The warp will require to be drawn through the heddles in the same order as shown at No. 56. The letters, A, B, C, D, represent the leaves, and the figures, 1, 2, 3, 4, 5, 6, 7 and 8, show the order of

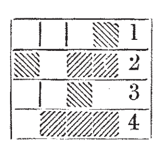
No. 56.

	5		1	A
7		3		B
	6		2	C
8		4		D

the draught. If the two leaves, A and B, were to be raised and sunk alternately, allowing C and D to stand still, plain cloth would be produced, and the warp yarn drawn into C and D would either be above or below the cloth, but more likely it would be both above and below, as the shuttle would be driven through that part of the warp at random. If the leaves marked C, D, be taken down every shot, when A and B are working plain cloth, then all the warp in C and D will be under the cloth. Again—if the leaves C and D be taken up every shot, when the leaves A and B are making plain cloth, then all the warp in C and D will be above the cloth. If A be raised, and the other three sunk for the first shot; C sunk, and the other three raised for the second shot; B raised, and the other three sunk for the third shot; D sunk, and the other three raised for the fourth shot, and this repeated for several times, the whole warp will be woven into two pieces of cloth, which will only be joined at the selvages. Let this be properly understood, and the method for making double cloth will be readily comprehended.

It will be seen from No. 57 how the tapets should be arranged in the barrel to produce this kind of cloth; the same arrangement also answers for how the cards should be cut, if the Jacquard machine is used for it,

No. 57.



and for some kinds of work, although it be plain cloth, it is necessary to use the Jacquard machine.

When weaving double cloth in the hand-loom, one or two extra treadles can produce a large variety of patterns, as the weaver can remember when the extra ones are to be brought into use; but in the power-loom the mounting requires to be as large as to complete one repeat of the pattern. The pattern given at No. 57 can be woven in the power-loom with a barrel with four treads, but the cloth will only be joined, as stated before, at the selvages. If the pattern to be woven requires 100 shots, the same as described for No. 57, and then 12 shots to join the two webs, that would make in all 112 shots for one repeat; so 112 cards will require to be used, if woven in the power-loom, whereas, in the hand-loom two extra treadles would only be required to produce the same effect.

The different apparatuses that are described in another place for weaving plain and tweeled cloth alternately, can be applied to weave double cloth in the power-loom; and for the hand-loom, as already observed, two or three extra treadles can give a great variety by the joining of the two webs in different places, to form figures the same as may be seen in Marseilles quilts or vestings.

TUBE WEAVING.

Woven tubes are used for many different purposes, such as those employed by brewers and bleachers for conveying their liquids from one place to another; they were also made at one time to answer for the small paper tubes, put on the spindles of spinning frames, to form the bottom of the pirns. For common gray yarn the paper ones answer very well, but when the yarn is to be bleached in the cope, the paper ones give way, and waste the yarn to a certain extent. It was to save this waste that cloth ones were brought into use, and an explanation of how they were woven will give the reader an idea how any other kind of tubes can be made.

The most difficult thing in weaving small cloth tubes, when they must be all of the same diameter, is to keep them to the proper size, because the least alteration in the wefting alters the size of the tube. A very simple contrivance keeps them all the same size; but, before it can be understood, it will be necessary to explain first how these tubes are woven.

In weaving tubes for long lengths, it is requisite to have the yarn that is to compose the warp of each tube on a reel or bobbin, and these bobbins are put upon an arbor which is placed in the loom in the same position that the yarn beam occupies; each bobbin is paced by a separate cord or spring. If the loom they are to be woven in has a reed space of 42 inches, and allowing three inches for each tube, then 14 tubes can be made at the same time; and the heddles will require to be divided into 14 divisions, to suit the bobbins that hold the warp. After the warp is drawn into the heddles in the order as shown at

No. 56, it is taken through the reed at regular intervals. The arrangement for the tapets is shown at page 362, under No. 57.

The lay is made much in the same manner as a common power-loom lay, without the ends for the shuttle boxes, and it has no protecting apparatus to stop it when any defect takes place, as it is not required; the warp yarn being double, it is sufficiently strong that when the shuttle stops in the shed, the pace on the bobbin yields to it without breaking the yarn. On the front of the lay are fixed two brackets for a wooden slide to work in, and on this slide is bolted a small brass driver for each shuttle, and one more, which makes 15 drivers in all for the 14 shuttles; this slide is driven from the common picking treadles, and, as it moves from one side to the other, it drives the small shuttles from right to left, and from left to right, through the sheds alternately.

The shape of the shuttle is like the letter D, half round; the straight side is kept to the reed, and if the brass driver does not send it wholly through the shed, the other side being part of a circle, when the shuttle comes to the cloth part of the tube, it is forced to take its place for the next shot. When there is about an inch of cloth woven, in each tube there is placed a round piece of wood of the same diameter as the internal size of the tube, which is kept always as far forward as the reed will touch the end of it every shot;

this piece of wood keeps the tube at its proper size, and the wood is prevented from moving forward with the cloth by a piece of thin iron fixed on the breast beam, through which iron the cloth that forms the tube has to pass in a flattened state; this iron is so set that the end of the round piece of wood is always kept forward to the face of the cloth.

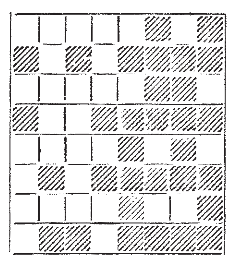
The weft used for these tubes is double yarn, the same as the warp, and it is wound upon small bobbins made to suit the shuttle; the weft passes through a small eye in the centre of the circle of the shuttle, and is kept to the proper tightness with a small spring which presses on the weft bobbin.

After the tubes are woven, they are put on brass wires, about five feet long, and the wires with the cloth on them are submerged into boiling starch; after they are dry, the wires are taken out, and the tubes cut into the lengths required. By putting them through this process, the tubes all stand open, which enables the spinner to get them on the spindles without difficulty.

In weaving tubes of a larger diameter, such as water-pipes, where the yarn requires to be coarse and strong, the common power-loom is not so applicable; therefore, looms are made for the purpose, the lay of which is very strong; and for each shuttle (or weft bobbin) a small frame is made, which slides into grooves made in the lay. These frames are made sufficiently long, so that the ends of them will enter the opposite groove before it is half out of the other groove.

Some of these tubes are woven with a four-leaf tweel, for the purpose of getting more weft on in a given space than what can be got on with plain weaving. In this case eight leaves are required, which makes two sets of a four-leaf tweel; the warp is drawn through the heddles in each set, the same as a common four-leaf tweel, and No. 58 shows how the tapets are arranged in the barrel, the black squares represent the leaves that are lifted to form the shed.

No. 58.



It will be obvious that a barrel with eight treads will be required for this.

INKLE LOOM.

What we have explained under the head "Tube Weaving," is almost a description of an inkle loom, which is the name given to that kind of loom which is used for weaving all kinds of tapes and other articles, such as braces, horse girth, ribbons, coach lace, &c., &c.

These looms are in general made very broad, for the purpose of taking in a greater number of tapes (or small webs). Each web has its own warp on a bobbin or beam, and each has its own shuttle. It is not requisite that all the tapes woven in the loom at the same time should be all of one kind. If they are all woven with the one set of heddles, they will be all plain cloth or tweel, or whatever that set of heddles may work; but it does not follow that they will require to be all of the same fineness, or the same breadth, or the same number of shots, because the construction allows of this variety to be woven in at the same time.

In some looms the taking up of the cloth is done by weights and pulleys, the weight always keeping the cloth at the proper tension. But a very good way for taking up the cloth is, to have a shaft running in the same position in the loom as the cloth beam, and on this shaft is a loose roll for the cloth, as it is woven to be wound on. This is accomplished by having a friction plate attached to each roll, and by the screw pins in the friction apparatus, the tension of the cloth can be regulated to any degree of nicety. It will be evident that the shaft must be driven at a greater speed than the speed at which the cloth is woven, or the friction would not take up the cloth; or in other words, the friction must always have a certain amount of slipping or slippage. The friction plates have been applied also for the purpose of keeping the warp yarn at its proper tension when in the act of being woven, instead of a pace; but it is found not to answer so well as the common pace, although it is much neater.

When weaving goods with figures on them, such as silk ribbons, the Jacquard machine can be applied to the inkle loom. And in this kind of work, when the loom is driven by steam or water-power, it is of great advantage to the weaver to have a weft stopper for each shuttle or ribbon; because if one of the shuttles is running without weft while the others are making cloth, the Jacquard machine cannot be turned back to find the proper shed, as is done in a common harness loom, and the only way is to allow it to run without weft, until the same card comes round to the place at which the weft broke; whereas, if each shuttle had a weft stopper, the loom would be stopped at the first, or at least at the second shot after the weft became broken or exhausted in the shuttle. Indeed, for all kinds of work it is better to have the weft stopper applied, and it can be easily done.

RICE AND SUGAR BAGS.

In the common power-loom, bags for holding sugar are made with the same tweel as shown at No. 58, and it will be observed that two leaves are raised and six sunk for the first shot; six raised and two sunk for the second shot, and so on alternately. The best ones are made with double warp and weft, which makes a very strong fabric; they are also used for holding rice. For this sort of work only one shuttle is required, there being only one bag woven at the same time. The advantage of having them made in this way is, that they have no seam, consequently, they are much stronger, and keep the sugar better in. The weaver for this kind of work requires to be very attentive, to see that none of the warp threads, when broken, are allowed to remain in the shed; otherwise, the two fabrics may be woven together at that part where the thread is in the shed, and this would spoil the bag.

In general these bags are sewed at the bottom, in the common way, but they can be made so as no seam is required at all, by using the Jacquard machine, instead of the barrel for working the heddle leaves. It is requisite, in starting a web of this kind, to have it treaded, so as the tweel will run regularly round the bag, and not to allow it to have the appearance of a reverse tweel at the selvages.

From what has been said on this subject, it will be apparent that many other things might be woven without a seam, such as pillow and bolster slips, bedding, petticoats, &c., &c.

BED AND TOILET COVERS.

Some of the very best covers for beds and toilets are made on the principle of double cloth weaving, and if the reader will look at what is stated under the head "Double Cloth," he will more readily comprehend what follows.

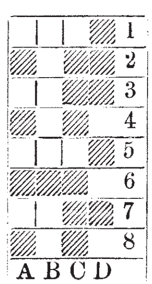
It altogether depends upon the quality of the cover wanted, what set of reed, also what kind of warp and weft should be used. The most common kind of covers is made with four leaves, without any figure, the one side of which is made with finer yarn than the other, and are woven together by having the tapets arranged in the barrel, as shown at No. 59; the draught is the same as a plain web.

C and D are the two fore-leaves, with the coarse warp drawn into them; A and B are the two back ones with the fine warp; the figures, Nos. 1, 2, 3, 4, 5, 6, 7, 8, represent the different treads; the black squares are the leaves that are to be raised, and the white ones those that are to be sunk. No. 1 tread makes the first shed, and the shuttle with the coarse weft is put through it, which makes the first shot for the top side of the cover. No. 2 tread makes the shed for the shuttle with the fine weft, and when it is put through, the first shot is made for the under side of the cover. No. 3 tread makes the shed that lifts all the coarse warp and sinks the fine; the coarse weft is put through this shed. No. 4 tread makes the shed which joins the two warps, and the fine weft is put through it. The treads, Nos. 5, 6, 7 and 8, are just another repeat of the same; and by continuing to work in this way, a cover will be produced with one side fine and the other coarse.

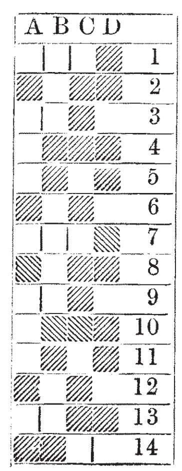
All the variety of figuring is produced upon these covers by fixing the two warps together, according to the pattern wanted, upon the following principle:—

Suppose No. 60 to be treaded according to how it is shown at the figures, 1, 2, 3 and 4, until the loom has

No. 59.



No. 60.



woven 108 shots, and 10 shots of weft (Scotch glass) put on, on each side of the cover; this will give one inch of cloth for each side, without putting any coarse weft between the two warps. When the leaves C and D are treaded, coarse weft is put in; and when the leaves A and B are treaded, fine weft is put in. The treads 5 and 6 join the two fabrics; and it is done by putting in fine weft. Then the treads, Nos. 7, 8, 9 and 10, are repeated for the same number of shots as the figures, 1, 2, 3 and 4, which will make another inch of cloth, and the treads 11 and 12 are those that join the fabrics. If this treading were continued, a stripe one inch broad would be produced without putting anything between the two warps; but if coarse weft is to be put in between the two warps for filling, then the heddles are treaded for that purpose, in the same manner as shown by the numbers 13 and 14.

To make this very simple pattern in the power-loom, it will require at least 218 cards, or two different barrels (or shedding gear), which can be brought into, or put out of motion, by an index whereon the pattern is arranged; but the cards with the small Jacquard machine is the most simple way of doing it. In the hand-loom it can be woven with a few treadles and marches. There are many small patterns that can be woven on bed and toilet covers, with heddle leaves, by employing as many as 16, and varying the draught; but when a fine flowery figure is wanted for the centre, and a border all round the cover, a harness must be used to produce the patterns; and, by taking advantage of the harness and heddle leaves, any figure can be woven to the extent of the cover, and how that can be done is fully explained in Chapter V., page 167. The only alteration that requires to be made, is in the tweeling barrel that works the heddles, and a double box put at each side of the lay.

Like any other figured work, the first thing to be done is to put the figures on design paper, and consider what kind of tweel is for the under side of the cloth, and what is for the upper. The harness being employed to form the figure and to fix the two fabrics together; and the heddle leaves for weaving the grounds, which can be either plain or tweeled, or the one plain and the other tweeled. It will be plain to those who have studied what has already been written, that any kind of figured bed-cover can be woven by using this kind of mounting, by whatever name they may go under: such as diamond quilt, waved quilt, Marseilles quilts, and fancy quilts, with any colour that may be thought proper to be put in, either in the warp or weft. With all those opportunities, some very beautiful things may be woven on bed and toilet covers.

WEAVING BROAD CLOTH IN A NARROW LOOM.

CRUMB-CLOTHS.

Crumb-cloths are, in general, either made of linen or worsted yarn, and are used for putting on the top of carpets for the purpose of keeping them clean. They are considered better to have no seam in them, and suppose one is wanted six yards wide, it would require a loom with at least 19 feet of reed space to weave it, which comes to be very expensive; to obviate the expense of such a large loom they can be woven in a loom two yards wide, on the double cloth principle, in the following manner:—

Let the fabric be equal to a 10^{00}, and the shrinkage be one in twenty, then the space that will require to be filled in the reed will be 222 inches, if woven in the common way; but in an eight-fourth loom with six threads in the split, the space required will be only 74 inches; and all the warp that is required will be put on the beam, so as to answer this space (viz., 74 inches), the quantity of which is 12,000 ends for the warp in the web. For the purpose of making our explanation better understood, we will suppose the ground for the crumb-cloth to be a four-leaf tweel, and to accomplish this, twelve leaves will be required, as there are in reality three webs on the one beam, and each web requires four leaves.

The web that is to be uppermost can be drawn on the four leaves that are next the lay, the centre web drawn into the four centre leaves, and the under web into the four back leaves.

The first shot that is thrown is for the top web, the second for the centre web, and the third for the under web. If the first shot be thrown from the right hand, the top web will be joined to the centre one at the left hand, as the second shot must be thrown from the left, and the third shot being thrown from the right, the centre web and the under one will be joined at the right hand; the fourth shot is put through the under web from the left hand, which forms the selvage for that side of the crumb-cloth; the fifth shot is put through the centre web from the right, and the sixth shot through the top web from the left, and back again through the top web, which forms the other selvage of the crumb-cloth; and this is repeated for the whole length of the web.

Examples are already given how a four-leaf tweel is drawn and treaded, and the main thing to be attended to in drawing this web, is to draw each set the same as any other four-leaf tweel, taking one thread on each set alternately. It will be apparent that a barrel with 24 treads will be required to work this cloth, as it takes six shots to make one repeat of the wefting, and four shots to make one repeat of the tweel; so that six multiplied by four is 24, the number of treads required.

The explanations given here will only do for a cloth with a plain or four-leaf ground; but if figures are required, a harness or larger mounting for working the sheds will be necessary, which can easily be applied even to this kind of work. When the cloth is woven, and taken off the loom, it will measure three times the breadth that it stands in it, whatever that breadth may be.

CARPETS.

Many of the carpets that are sold at the present time are woven upon the double cloth principle, and are called two-ply and three-ply carpets. If the warps are to form the flowers, they may be woven with one shuttle, and the heddles (or harness) are made to lift that portion of the warp which is requisite to form the flower. The colours that are introduced into the flowers will depend upon the arrangement of them in the warps. Suppose it is a three-ply carpet, and each warp to be all one colour, one red, one blue, and one orange; the designer will have only these three colours to work upon in drawing the patterns. They may be drawn so as one flower may have all the three colours in it, or just the one; that will depend entirely upon what is wanted; the scope for variety with one shuttle, when there are three warps employed, is greatly increased over the two-ply carpets, as one set of flowers may be all red, one set all blue, another set all orange, another set red and blue, another set red and orange, another set orange and blue, and another set red, blue and orange, besides all the imaginable arrangements of the colours that may be introduced into the different warps in the shape of stripes. When only one shuttle is employed, and that shuttle to throw in blue weft, the figure will be brightest where the blue weft crosses the blue warp; but, so as the colours may all be as bright as possible with the one wefting, the warp of the web is made much coarser than the weft.

Another way of making two and three-ply carpets, which makes a superior article, is to have as many colours in the weft as there are in the warp. This may cause the use of a great number of shuttles, but it brings up fine bright flowers where the same colour of weft and warp are made to cross each other; this is done by observing what card is made to lift the harness for the different colours, and putting in a shuttle with the same colour of weft as the warp which it is to cross, to form the flower.

In designing patterns for this kind of work, particular care must be taken to have the design painted, so as the card cutter will know what parts are to be cut, and what are to be left blank on each card; for, in reality, there will be three different sets of cards required for a three-ply carpet, although they are all laced together as one set for the weaver.

For some of the more simple kinds of carpets, with small figures woven on them, instead of using the Jacquard machine for working the harness, a barrel is placed above the loom, whereon the pattern is arranged. It is something similar to the barrel of an organ, and the small pieces of wires that are fixed in it to play the tune, are made to move that part of the harness which is to be lifted to form the figure, the particulars of which need not be explained here, as the movements are similar to those described under tweeling mountings, the wires being arranged in the same manner as the tapets are in the tweeling or diaper barrels.

Mr. Morton, of Kilmarnock, at one time made these barrels, to a considerable extent, for weaving carpets; but the cards for the Jacquard machine can be made much cheaper now, which, to a certain extent, supersedes the use of Mr. Morton's barrel, even for small patterns. This barrel does for other kinds of figured work as well as for carpets; and it may be observed that it requires to be divided into as many divisions as there are lifts of the harness in one repeat of the pattern, and that the wires or pegs are put in according to the figure on the design paper.

We have given in this chapter an explanation of mountings for working the different kinds of tweels, from a three to a sixteen-leaf. In that explanation, the wyper, the pulley, the scroll, and the star kinds have been taken notice of for sinking the heddle leaves, also different plans for lifting the heddles, such as weights, springs, and the Jacquard machine. We will finish this chapter by briefly noticing a few other plans for working the heddle leaves; for to make remarks on all would take up too much space.

Mr. Patrick Robertson, of Rutherglen Weaving Mill, took out a patent some years ago, the principle of which was to control the movements of heddle leaves for certain kinds of work, and his plan was considered a very good one; however, our remarks, under the following head, will not be entirely confined to this patent, but will embrace different ways how the same kind of work can be woven.

PLAIN AND TWEEL, WITH WEFT CORDS.

It is shown at page 335, how four shots of plain and four shots of tweel cloth, alternately, can be woven. When the patterns are small (for any that will be completed under thirty-seven shots), the tweeling barrel is the simplest mounting that can be used; but if a pattern, the same as the one given under No. 61, requires to be woven, then it cannot be made with the barrel.

No. 61.

7	shots for	a cord.
24	„	plain cloth.
7	„	a cord.
49	„	tweeled cloth.
7	„	a cord.
24	„	plain cloth.
118		

This pattern is woven with four leaves, the warp is drawn through the heddles in the same order as for plain work; and for making the plain cloth part of the pattern, the common wypers are used, and for the tweel part of it a common four-leaf barrel. The four leaves of heddles are corded to the four tweeling treadles in the usual way, but the two plain treadles are corded so as the leaves are at liberty to be moved by the tweeling barrel when it comes into motion; both the plain treadles and tweeling ones are so arranged that they can be put in and out of gear at pleasure. A ratchet wheel may be employed as the regulator of the pattern, and for this one it will require 118 teeth. The first part of the pattern is a cord which is made by putting in seven shots of weft into the same shed; this is accomplished by keeping the plain shed open for seven shots, the weft being made to turn upon one single thread at each selvage; the selvage threads may be made to perform this part independent of the heddle leaves. The second part of the pattern is 24 shots for plain cloth. The third part of the pattern is again seven shots of weft for a cord. The fourth part is 49 shots for the tweeling. The fifth part is again seven shots for a cord; and then for the sixth part 24 shots for plain. This makes one repeat of the pattern, which is all arranged on the ratchet wheel. On the one side of the wheel there are placed nobs or pins for putting the shedding motion into gear; the pins on the other side are used for putting the shedding motion out of gear.

It will be evident, from what has already been stated, that, instead of a ratchet wheel for the regulator of the pattern, the Jacquard machine and the endless chain, used for working the heddle leaves, will answer the same purpose; however, the wheel will answer in this place for the illustration of the other parts.

The regulator of the pattern should be got at, with the least possible trouble to the weaver, and easily shifted to its proper position when any derangement takes place in the pattern. This has not been attended to in any of the looms which have come under the notice of the writer; but in some plans the very reverse, by putting the index or regulator of the pattern away below the loom. To any person at all acquainted with power-loom weaving, it will be apparent that the best place is to have it at the handle side of the loom, right opposite the weaver, on the upright of the heddle-bearer. Suppose it placed in that position, all that is required to be in connection with the ratchet wheel is two small levers; these levers, when acted upon, put in motion the apparatus for shifting the treadles or wypers; for the object to be attained can be done either by shifting the wypers from off the treadles, or by allowing the treadles to fall out of gear from the wypers. If the wypers are to be acted upon, they are made to slide upon their respective shafts to one side, to be out of gear with the treadles. This is accomplished by having a long key made fast on the shaft, and a key seat cut in the wypers to correspond to it. The proper time for the wypers to be shifted is when the heddle leaves are close; and when the one set goes into gear, the other must go out at the same instant.

When the wypers are to be kept always in the same place upon their shafts, and the treadle to be acted upon for changing the shedding motion, a small arbor is placed for each set of treadles right below the treadle heel pins. These arbors are fitted with an eccentric on each end for supporting the treadle heel pin, and a slit is made in the treadle heel, for the purpose of allowing the pin to move up or down. When the arbor is turned, so as the full side of the eccentrics are up, the treadles will be in gear with the wypers, and that set of treadles will be put in motion for shedding the heddles; the reverse will take place when the full side of the eccentrics are down. The same appliance which can shift the wypers can be made to turn the arbors, and that may consist of either a spring or weight, or a lever brought into contact with a cam, put on the under shaft of the loom for that purpose.

The arrangements just explained place the wypers for working the plain cloth on the common wyper shaft; but, by making suitable wypers for the plain cloth, they may be fixed on the same shaft with the tweeling ones, and, in many instances, this is the preferable way of doing it.

TAPE CHECKS, MADE WITH ONE SHUTTLE.

Tape checks are now very common; they were originally made in the hand-loom, but now mostly made by power. The ground of the cloth is similar to that of a jaconet, and they are striped in the warp and weft, by putting in coarser yarn, or a number of plies of fine, to form the stripes. They are taken notice of here for the purpose of explaining how they are made with one shuttle; and for the guidance of those unacquainted with this fabric it may be of use to state what numbers of yarns they are made of:—

For a 10^{00} 60s Warp, with 80s weft.
„ 12^{00} 70s „ „ 90s „
„ 14^{00} 80s „ „ 100s „

The sizes of yarn given here are those that are commonly used, but some tape checks are made with much finer yarns, for the purpose of making the ground of the cloth more transparent. Suppose the pattern to be two inches of fine and 12 shots of coarse weft alternately, the coarse yarn being two ply of 40's, and the fine 80's single; the usual way to make this pattern is to have one shuttle for the fine and another for the coarse weft, and change them either by hand or with a double box.

To make this pattern with one shuttle, the same apparatus that has been explained for making the cord in No. 61 will do for making the tape in this pattern, by putting in four shots of No. 80's in one shed, then changing the shed and putting in other four shots, and repeating this for 12 times, which will be equal to 12 shots of coarse weft, because four ply of 80's are equal to two ply of 40's.

After this, the wypers are allowed to work two inches of plain cloth to form the body of the check, and that will complete the pattern. It will be apparent that this plan of making tape checks is more suitable for small patterns than large ones.

For keeping the shed open for the purpose of throwing in more shots than one, some parties do it differently from the method just explained. One of the plans is to draw the small pulley out from under the wyper, and, by doing so, it is not acted upon by the wyper to form the shed, while the other is locked down to hold the shed open. Another way is to have a spiral spring placed between one of the treadles and the heddles, this spring to be sufficiently strong to form the shed when the other treadle is not locked, and when it is locked to keep the shed open. The spring will yield to the action of the wyper. Another way is to have both wypers loose on the shaft, and a clutch for each wyper, which can be made to gear with them, when their actions are required for the shedding.

There is another machine for working heddle leaves, known in the trade by the name "Dobie," which some manufacturers use in preference to those plans just described. This machine is very well got up, and is one of those which will work almost any kind of pattern that can be made with heddles. It is placed in the same position on the loom as the skeleton Jacquard machine; and as it is just another modification of the Jacquard machine, no further notice of it is required in this place.

CHAPTER IX.

CALCULATIONS, TABLES, &c.

COSTING GOODS.

The meaning of costing is to find, by calculation, what money it will cost the manufacturer to make a given piece of cloth. It is very important that the person whose charge it is to rate the goods should have some uniform method to keep by, because, changing from one system to another, they are apt to forget some item in their calculation; therefore, before making any further remarks about the costing of goods, we will give a few specimens of rating. The prices affixed are nominal, as the specimens given are merely to show the principle of rating goods.

Rating for 50 yards of a 36 inch 12^{00} *shirting, with 14 shots.*

	Lbs.	Rate.			Pence.
Length, 50 yards, - - - - -					
Width, 36 inches, - - - - -					
Splits, 1265, - - - - - -					
Ends, 2530, - - - - - -					
Warp No. 32's, 165 hanks, - - - -	$5\frac{1}{6}$	£0	1	3	$77\frac{1}{2}$
Weft No. 32's, $192\frac{1}{2}$ hanks, - - - -	6	0	1	2	84
Warping, - - - - - - -					2
Dressing, - - - - - - -					5
Weaving, - - - - - - -					25
Charges, - - - - - - -					20
Total cost, - - - - - - -					$213\frac{1}{2}$
Discount, 5 per cent., - - - - -					$10\frac{1}{4}$
Cost per yard, $4\frac{1}{2}$d., - - - - -					$223\frac{3}{4}$
To sell at $4\frac{3}{4}$d. per yard, 5 per cent. off,					

It is better when rating goods to put down the amount in pence as in the specimens given, and also to add, as in this case, the shrinkage and waste into the number of hanks of both warp and weft.

In the above rating the whole cost, with 5 per cent. added, is $223\frac{3}{4}$ pence, which, when divided by 50 (the length of the piece) shows the price to be $4\frac{1}{2}$d per yard, nearly.

Rating for a 12^{00} *tape check with* 11 *shots.*

	Lbs.	Rate.			Pence.
Length, 50 yards, - - - - -					
Breadth, 32½ inches, - - - - -					
Splits, 1024 for fine, 96 for coarse,=1120,					
Ends, 2048, No. 70's, 430, No. 50,=2478,					
Warp No. 70's, 130 hanks, - - -	1·85	£0	2	3	50¼
Warp No. 50's, 28 hanks, - - - -	·56	0	1	6	10
Weft No. 90's, 120 hanks, - - -	1·33	0	2	2	34¾
Weft No. 40's, 2 ply, 20 hanks, - -	·50	0	1	3	7½
Dressing, - - - - - - -					3½
Weaving, - - - - - - -					22
Charges, - - - - - - -					20
Total cost, - - - - - - -					148
Discount, - - - - - - -					8
Cost per yard, 3·12 per yard, - -					156
To sell at 14s. per piece, - - -					

In the above fabric there are 430 ends of No. 50's warp for the tape, and 12 tapes in the breadth of the web, giving 34 ends for each tape, and 22 ends for selvage yarn. There are eight splits occupied for each tape, with four ends in each split, except the two outside splits, they having five ends in each, to form a cord or finish at the edges of the tape; this makes up the 34 ends for each tape.

Rating for a blue and white check.

	Lbs.	Rate.			Pence.
Reed, 10^{00}, - - - - - -					
Shots, 12, - - - - -					
Length, 72 yards, - - - -					
Breadth, 38 inches, - - -					
Splits, 1065, - - - - -					
Ends, 1062 for blue, 1068 for white,=2130,					
Warp 24's for blue, 102 hanks, -	4·25	£0	1	0	51
Warp 20's for white, 102 hanks, -	5·10	0	0	11	56½
Weft 20's for blue, 123 hanks, -	6·15	0	0	10	61½
Weft 16's for white, 123 hanks, -	7·68	0	0	9½	73½
Bleaching half of the warp and weft, -	12·78	0	0	1	13
Dyeing, - - - - - -	10·40	0	0	5	52½
Winding 11⅓ spyndles warp, at 1d., 13⅔ weft, 1½d.,					32
Warping, - - - - - -					5
Dressing, - - - - - -					9
Weaving, - - - - - -					115
Charges, - - - - - -					24
Total cost nett, - - - -					493
Price per yard, 6·84, - - -					
Selling price per yard, 7½d., - -					

The above rating is made out on the supposition that the web is to be woven in the hand-loom, the web being dressed and prepared in the same manner as for the power-loom. The white warp is rather less than 56½ pence, also the white weft is less than 73½, but the manufacturer takes the benefit of the fractions.

FORM FOR RATING BOOK.

				Lbs.	Rate.	Pence.
Date,			- - - - - - -			
Reed,			- - - - - - -			
Shots,			- - - - - - -			
Length,			- - - - - -			
Breadth,			- - - - - - -			
Splits,			- - - - - -			
Ends or runners,			- - - -			
Warp,	cotton,	hanks,	- -			
Warp,	silk,	hanks,	- -			
Warp,	lace yarn,	hanks,	- -			
Weft,	cotton,	hanks,	- -			
Weft,	silk,	hanks,	- -			
Whip,			- - - - - -			
Bleaching,			- - - - - -			
Dyeing,			- - - - - -			
Winding,	spyndles,		- - -			
Warping,			- - - - - -			
Dressing,			- - - - - -			
Drawing or twisting,			- - - -			
Weaving,			- - - - - -			
Finishing,			- - - - - -			
Charges,			- - - - - -			
Total cost,			- - - - - -			
Price per piece,			- - - - -			
Price per yard,			- - - - -			

The above is considered one of the best forms, as it will answer for most kinds of work; and the manufacturer, by having the rating book ruled and printed according to this form, or any other he may think better, will save himself a considerable amount of trouble. A blank space should be left at the bottom of each page for remarks.

ONCOST OR CHARGES.

Before the charges can be properly ascertained for any piece of goods, it is necessary to know what may be called the rent of the loom, also the sum that is required for furnishings, &c., and this will entirely depend upon the nature of the cloth to be woven.

For some power-loom factories, where common light cloth is to be woven, the whole outlay for buildings, boilers, engines, gearing, winding, warping, and dressing machines; looms, water, steam and gas pipes, along with warehouse furniture, will not be more than £21 per loom, supposing the factory to be as large as will contain 500 looms, as the smaller the factory is it will cost the more per loom.

For weaving some kinds of goods, the outlay per loom is as high as £80 before cloth can be made; and the cost of a shed with about 250 looms, for weaving winceys and fancy dress goods, has been found to be from £36 to £42 per loom, the price depending upon the kind of looms put in. This includes everything in connection with the factory that is required before it can be started to make cloth—such as gearing (large and small), winding machines, beaming machines, twisting frames, warehouse and counting-house furniture, pirns and pirn boards, bobbins and heddle shafts. But this sum does not include reeds or heddles, for these two articles may cost a very large sum if a great many different kinds of goods are to be made in the factory. However, we will take the outlay at £30 per loom for a data, to show how the oncost expenses, or charges are found; what that £30 is made up of will be shown in another place.

In a mill with 500 looms, the following sums affixed to the different articles have been found in practice to be nearly correct, taking an average of a few years. This statement, except the first seven items, and two or three others, was given to the writer, by a manager in the power-loom trade, who has had long experience in the management of power-loom factories; but every manufacturer will require to find out the exact sum for himself, which can be easily done at the end of six or twelve months. The amounts given in this place are for one year.

STATEMENT OF EXPENSES FOR ONE YEAR.

500 looms, at the rate of £30 each, is £15,000.

1.—Interest on £15,000 at 5 per cent., - -	£750	0	0
2.—Depreciation for one year, - - - - -	750	0	0
3.—Insurance on Mill and Stock, - - -	270	0	0
4.—Feu-duty, poor and police rates, &c., say -	240	0	0
5.—For gas, nett, - - - - - - -	114	8	10
6.—Water for boilers, &c., - - - - -	95	0	0
7.—Manager's salary, - - - - - -	180	0	0
	£2399	8	10
8.—Fuel, 1245 waggons, at 4s. 6d., - - - -	280	2	6
9.—Reedmaker's account for one year, - -	65	10	0
10.—Heddles, - - - - - - - -	133	0	0
11.—Rods, heddles, shafts, and shuttles, - -	57	8	0
12.—Castings, iron, and work done out, - -	279	0	0
13.—Ironmongery, - - - - - - -	33	0	0
14.—Brushes, - - - - - - - -	24	16	6
15.—Tinsmith's account, - - - - - -	19	0	0
16.—Ropespinner's account for pace cord, &c., -	22	0	0
17.—Shuttle cords, - - - - - - -	146	0	0
18.—Oil, tallow, and soap, - - - - -	280	0	0
19.—Heddle paint, - - - - - - -	6	12	0
20.—Wood, - - - - - - - -	27	0	0
21.—Shuttle drivers, - - - - - -	25	10	0
22.—File cutter, - - - - - - -	6	5	0
23.—Cooperage, - - - - - - -	3	8	0
24.—Leather, - - - - - - -	56	0	0
Carried forward, - - - - -	£3864	0	10

	£	s.	d.
Brought forward, - - - - -	£3864	0	10
25.—Glazier's Account, - - - - - -	11	10	0
26.—Slater's Account, - - - - - -	4	7	0
27.—Plumber's Account, - - - - - -	3	14	0
28.—Stationery, - - - - - - -	27	15	0
29.—Doctor's Expenses, - - - - - -	5	0	0
30.—Incidental Expenses, - - - -	69	11	0
	£3985	17	10

To the above list must be added the following sums for wages:—

	£	s.	d.
31.—1 Watchman for Night, 15s. per week, -	£39	0	0
32.—1 Gatekeeper, 10s. per week, - - - -	26	0	0
33.—2 Sweepers for Cleaning, &c., 7s. 6d., -	39	0	0
34.—1 Engineman, 24s. per week, - - - -	62	8	0
35.—For Porterage, - - - - - - -	32	0	0
36.—Blacksmith and Mechanics' Wages, - -	196	16	0
37.—Wages for Warehouse hands, - - - -	199	0	0
38.—Dressing-master, 30s. per week, - -	78	0	0
39.—Twisting-master, 20s. per week, - -	52	0	0
40.—Cleaning Flues, Boilers, &c., - - - -	6	0	0
41.—Rent for Town Warehouse and Taxes, -	90	0	0
42.—Salesman, Clerk, and Porter's Wages, -	270	0	0
43.—Postage Stamps and other Expenses, -	10	0	0
	£5086	1	10

After taking off the holidays, fast-days, &c., not more than 300 working days can be calculated upon for one year; so the sum, £5086 1s. 10d. divided by 300, and the product by 500 (the number of looms), will give the charge for one loom per day.

EXAMPLE.

```
        £5086  1  10
            20
        ----------
        101721
            12
        -------
300)1220662(4068
        1200
        ------
          2066
          1800
          -----
           2662
           2400
           -----
            262
        Say  4069
    500)4069(8 1/8
            4000
            -----
              69
               8
            -----
             552
            -----
```

This calculation shows that the expense for one loom per day to be eight pence and one-eighth, which gives four shillings and three farthings per week; and suppose that one loom will produce three pieces of cloth per week, the charges for one piece will be one shilling and fourpence farthing. To this will require to be added any wages that are not put down specially in the rating, such as the tenter's wages, which is not shown in the form given for the rating book.

The foregoing statement and observations have been made more for the guidance of new beginners than for those already in the trade, for every manufacturer who takes the trouble to look into his accounts at the end of the year soon finds out what the oncost charges are. And it will be apparent, that if the production can be increased from three pieces per week to four or five, the charge upon one piece will be considerably less. And it may be remarked, that the desire to make a loom to produce as much as possible in a given time has been the great stimulant for the many improvements that have been made in power-looms of late. When it is taken into consideration how these improvements are taken advantage of, by people putting up new works, the reader will not be surprised at the item, No. 2, which is £750 per annum, being put down in the statement; for the fact is, that even five per cent. does not compensate, in many instances, for the depreciation that takes place in the machinery used for weaving by power; and it would be better for those in the trade, if they can manage it at all, to throw out their old machinery and put in new whenever it is proven that the new is better, either for quantity or quality; for if they do not, they are sure to be cut out of the trade by the parties who have got the improved machinery, as they are enabled to undersell them in the market, and have a profit too. However, this will be shown more clearly in another place.

MANUFACTURERS', WARPERS' AND BEAMERS' TABLES.

The annexed tables are to show the quantity of yarn contained in any given web. The use of them will be apparent to the beamer, warper, and manufacturer, as they will save time in calculation. The first column to the left hand side of each page are splits. The figures in the second column represent the porters contained in the number of splits on the same line. The first row of figures on the top of the page are ells; and the second row are yards. The body of the pages show the number of spyndles, hanks, and parts of a hank. Examples are given at the end of the tables how they can be applied by the warper, beamer, &c.

Ells.		$\frac{4}{5}$		$1\frac{3}{5}$		$2\frac{2}{5}$		$3\frac{1}{5}$		4		$4\frac{4}{5}$	
Yards.		1		2		3		4		5		6	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk
2	$\frac{1}{10}$												
4	$\frac{1}{5}$												
5	$\frac{1}{4}$												
10	$\frac{1}{2}$								$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$
20	1				$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{2}{7}$		$\frac{2}{7}$
30	$1\frac{1}{2}$				$\frac{1}{7}$		$\frac{1}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{3}{7}$
40	2		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{4}{7}$
50	$2\frac{1}{2}$		$\frac{1}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{4}{7}$		$\frac{5}{7}$
60	3		$\frac{1}{7}$		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{4}{7}$		$\frac{5}{7}$		$\frac{6}{7}$
70	$3\frac{1}{2}$		$\frac{1}{7}$		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{5}{7}$		$\frac{6}{7}$		1
80	4		$\frac{1}{7}$		$\frac{3}{7}$		$\frac{4}{7}$		$\frac{5}{7}$		1		$1\frac{1}{7}$
90	$4\frac{1}{2}$		$\frac{1}{7}$		$\frac{3}{7}$		$\frac{4}{7}$		$\frac{6}{7}$		1		$1\frac{2}{7}$
100	5		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{5}{7}$		1		$1\frac{1}{7}$		$1\frac{3}{7}$
200	10		$\frac{3}{7}$		1		$1\frac{3}{7}$		$1\frac{6}{7}$		$2\frac{3}{7}$		$2\frac{6}{7}$
300	15		$\frac{5}{7}$		$1\frac{3}{7}$		$2\frac{1}{7}$		$2\frac{6}{7}$		$3\frac{4}{7}$		$4\frac{2}{7}$
400	20		1		$1\frac{6}{7}$		$2\frac{6}{7}$		$3\frac{6}{7}$		$4\frac{5}{7}$		$5\frac{5}{7}$
500	25		$1\frac{1}{7}$		$2\frac{3}{7}$		$3\frac{4}{7}$		$4\frac{5}{7}$		6		$7\frac{1}{7}$
600	30		$1\frac{3}{7}$		$2\frac{6}{7}$		$4\frac{2}{7}$		$5\frac{5}{7}$		$7\frac{1}{7}$		$8\frac{4}{7}$
700	35		$1\frac{5}{7}$		$3\frac{2}{7}$		5		$6\frac{5}{7}$		$8\frac{2}{7}$		10
800	40		$1\frac{6}{7}$		$3\frac{6}{7}$		$5\frac{5}{7}$		$7\frac{4}{7}$		$9\frac{4}{7}$		$11\frac{3}{7}$
900	45		$2\frac{1}{7}$		$4\frac{2}{7}$		$6\frac{3}{7}$		$8\frac{4}{7}$		$10\frac{5}{7}$		$12\frac{6}{7}$
1000	50		$2\frac{3}{7}$		$4\frac{5}{7}$		$7\frac{1}{7}$		$9\frac{4}{7}$		$11\frac{6}{7}$		$14\frac{2}{7}$
2000	100		4		$9\frac{4}{7}$		$14\frac{2}{7}$	1	1	1	$5\frac{6}{7}$	1	$10\frac{4}{7}$
3000	150		$7\frac{1}{7}$		$14\frac{2}{7}$	1	$3\frac{3}{7}$	1	$10\frac{4}{7}$	1	$17\frac{5}{7}$	2	$6\frac{6}{7}$
4000	200		$9\frac{4}{7}$	1	1	1	$10\frac{4}{7}$	2	$2\frac{1}{7}$	2	$11\frac{4}{7}$	3	$3\frac{1}{7}$

Ells.		$5\frac{3}{5}$		$6\frac{2}{5}$		$7\frac{1}{5}$		8		$8\frac{4}{5}$		$9\frac{3}{5}$	
Yards.		7		8		9		10		11		12	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$				$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$
5	$\frac{1}{4}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$
10	$\frac{1}{2}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$
20	1		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{4}{7}$
30	$1\frac{1}{2}$		$\frac{3}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{6}{7}$
40	2		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{6}{7}$		1		$1\frac{1}{7}$		$1\frac{1}{7}$
50	$2\frac{1}{2}$		$\frac{6}{7}$		1		1		$1\frac{1}{7}$		$1\frac{2}{7}$		$1\frac{3}{7}$
60	3		1		$1\frac{1}{7}$		$1\frac{2}{7}$		$1\frac{3}{7}$		$1\frac{4}{7}$		$1\frac{5}{7}$
70	$3\frac{1}{2}$		$1\frac{1}{7}$		$1\frac{2}{7}$		$1\frac{3}{7}$		$1\frac{5}{7}$		$1\frac{6}{7}$		2
80	4		$1\frac{2}{7}$		$1\frac{4}{7}$		$1\frac{5}{7}$		$1\frac{6}{7}$		2		$2\frac{2}{7}$
90	$4\frac{1}{2}$		$1\frac{3}{7}$		$1\frac{5}{7}$		$1\frac{6}{7}$		$2\frac{1}{7}$		$2\frac{2}{7}$		$2\frac{4}{7}$
100	5		$1\frac{5}{7}$		$1\frac{6}{7}$		$2\frac{1}{7}$		$2\frac{3}{7}$		$2\frac{5}{7}$		$2\frac{6}{7}$
200	10		$3\frac{2}{7}$		$3\frac{6}{7}$		$4\frac{2}{7}$		$4\frac{5}{7}$		$5\frac{1}{7}$		$5\frac{5}{7}$
300	15		5		$5\frac{5}{7}$		$6\frac{3}{7}$		$7\frac{1}{7}$		$7\frac{6}{7}$		$8\frac{4}{7}$
400	20		$6\frac{5}{7}$		$7\frac{4}{7}$		$8\frac{4}{7}$		$9\frac{4}{7}$		$10\frac{4}{7}$		$11\frac{3}{7}$
500	25		$8\frac{2}{7}$		$9\frac{4}{7}$		$10\frac{5}{7}$		$11\frac{6}{7}$		13		$14\frac{2}{7}$
600	30		10		$11\frac{3}{7}$		$12\frac{6}{7}$		$14\frac{2}{7}$		$15\frac{5}{7}$		$17\frac{1}{7}$
700	35		$11\frac{5}{7}$		$13\frac{2}{7}$		15		$16\frac{5}{7}$	1	$\frac{2}{7}$	1	2
800	40		$13\frac{2}{7}$		$15\frac{2}{7}$		$17\frac{1}{7}$	1	1	1	$2\frac{6}{7}$	1	$4\frac{6}{7}$
900	45		15		$17\frac{1}{7}$	1	$1\frac{2}{7}$	1	$3\frac{3}{7}$	1	$5\frac{4}{7}$	1	$7\frac{5}{7}$
1000	50		$16\frac{5}{7}$	1	1	1	$3\frac{3}{7}$	1	$5\frac{6}{7}$	1	$7\frac{1}{7}$	1	$10\frac{4}{7}$
2000	100	1	$15\frac{2}{7}$	2	$2\frac{1}{7}$	2	$6\frac{6}{7}$	2	$11\frac{4}{7}$	2	$16\frac{2}{7}$	3	$3\frac{1}{7}$
3000	150	2	14	3	$3\frac{1}{7}$	3	$10\frac{2}{7}$	3	$17\frac{3}{7}$	4	$6\frac{4}{7}$	4	$13\frac{5}{7}$
4000	200	3	$12\frac{5}{7}$	4	$4\frac{1}{7}$	4	$13\frac{5}{7}$	5	$5\frac{2}{7}$	5	$14\frac{5}{7}$	6	$6\frac{2}{7}$

Ells.		$10\frac{2}{5}$	$11\frac{1}{5}$	12	$12\frac{4}{5}$	$13\frac{3}{5}$	$14\frac{2}{5}$
Yards.		13	14	15	16	17	18
Splits.	Porters.	Sp. Hk.	Sp. Hk.	Sp. Hk.	Sp. Hk.	Sp. Hk	Sp. Hk.
2	$\frac{1}{10}$						
4	$\frac{1}{5}$	$\frac{1}{7}$	$\frac{1}{7}$	$\frac{1}{7}$	$\frac{1}{7}$	$\frac{2}{7}$	$\frac{2}{7}$
5	$\frac{1}{4}$	$\frac{1}{7}$	$\frac{1}{7}$	$\frac{1}{7}$	$\frac{1}{7}$	$\frac{2}{7}$	$\frac{2}{7}$
10	$\frac{1}{2}$	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{3}{7}$	$\frac{3}{7}$	$\frac{3}{7}$	$\frac{3}{7}$
20	1	$\frac{4}{7}$	$\frac{4}{7}$	$\frac{5}{7}$	$\frac{5}{7}$	$\frac{5}{7}$	$\frac{6}{7}$
30	$1\frac{1}{2}$	$\frac{6}{7}$	1	1	$1\frac{1}{7}$	$1\frac{1}{7}$	$1\frac{2}{7}$
40	2	$1\frac{2}{7}$	$1\frac{3}{7}$	$1\frac{3}{7}$	$1\frac{4}{7}$	$1\frac{5}{7}$	$1\frac{5}{7}$
50	$2\frac{1}{2}$	$1\frac{4}{7}$	$1\frac{5}{7}$	$1\frac{5}{7}$	$1\frac{6}{7}$	2	$2\frac{1}{7}$
60	3	$1\frac{6}{7}$	2	$2\frac{1}{7}$	$2\frac{2}{7}$	$2\frac{3}{7}$	$2\frac{4}{7}$
70	$3\frac{1}{2}$	$2\frac{1}{7}$	$2\frac{3}{7}$	$2\frac{4}{7}$	$2\frac{5}{7}$	$2\frac{6}{7}$	3
80	4	$2\frac{3}{7}$	$2\frac{4}{7}$	$2\frac{6}{7}$	3	$3\frac{1}{7}$	$3\frac{3}{7}$
90	$4\frac{1}{2}$	$2\frac{5}{7}$	3	$3\frac{1}{7}$	$3\frac{3}{7}$	$3\frac{4}{7}$	$3\frac{6}{7}$
100	5	$3\frac{1}{7}$	$3\frac{3}{7}$	$3\frac{4}{7}$	$3\frac{6}{7}$	$4\frac{1}{7}$	$4\frac{2}{7}$
200	10	$6\frac{1}{7}$	$6\frac{4}{7}$	$7\frac{1}{7}$	$7\frac{4}{7}$	8	$8\frac{4}{7}$
300	15	$9\frac{2}{7}$	10	$10\frac{5}{7}$	$11\frac{3}{7}$	$12\frac{1}{7}$	$12\frac{6}{7}$
400	20	$12\frac{3}{7}$	$13\frac{3}{7}$	$14\frac{2}{7}$	$15\frac{2}{7}$	$16\frac{2}{7}$	$17\frac{1}{7}$
500	25	$15\frac{3}{7}$	$16\frac{4}{7}$	$17\frac{6}{7}$	1 1	1 $2\frac{1}{7}$	1 $3\frac{3}{7}$
600	30	1 $\frac{4}{7}$	1 2	1 $3\frac{3}{7}$	1 $4\frac{6}{7}$	1 $6\frac{2}{7}$	1 $7\frac{5}{7}$
700	35	1 $3\frac{5}{7}$	1 $5\frac{2}{7}$	1 7	1 $8\frac{5}{7}$	1 $10\frac{2}{7}$	1 12
800	40	1 $6\frac{5}{7}$	1 $8\frac{4}{7}$	1 $10\frac{4}{7}$	1 $12\frac{3}{7}$	1 $14\frac{2}{7}$	1 $16\frac{2}{7}$
900	45	1 $9\frac{6}{7}$	1 12	1 $14\frac{1}{7}$	1 $16\frac{2}{7}$	2 $\frac{3}{7}$	2 $2\frac{4}{7}$
1000	50	1 13	1 $15\frac{2}{7}$	1 $17\frac{5}{7}$	2 $2\frac{1}{7}$	2 $4\frac{3}{7}$	2 $6\frac{6}{7}$
2000	100	3 $7\frac{6}{7}$	3 $12\frac{4}{7}$	3 $17\frac{3}{7}$	4 $2\frac{1}{7}$	4 $8\frac{6}{7}$	4 $13\frac{5}{7}$
3000	150	5 $2\frac{6}{7}$	5 10	5 $17\frac{1}{7}$	6 $6\frac{2}{7}$	6 $13\frac{3}{7}$	7 $2\frac{4}{7}$
4000	200	6 $15\frac{6}{7}$	7 $7\frac{2}{7}$	7 $16\frac{6}{7}$	8 $8\frac{3}{7}$	8 $17\frac{6}{7}$	9 $9\frac{3}{7}$

Ells.		15 1/5		16		16 4/5		17 3/5		18 2/5		19 1/5	
Yards.		19		20		21		22		23		24	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	1/10												
4	1/5		2/7		1/7		1/7		1/7		1/7		1/7
5	1/4		2/7		2/7		2/7		2/7		2/7		2/7
10	1/2		3/7		3/7		3/7		4/7		4/7		4/7
20	1		6/7		1		1		1 1/7		1 1/7		1 1/7
30	1 1/2		1 2/7		1 3/7		1 3/7		1 4/7		1 4/7		1 5/7
40	2		1 6/7		1 6/7		2		2 1/7		2 1/7		2 2/7
50	2 1/2		2 1/7		2 3/7		2 4/7		2 5/7		2 5/7		2 6/7
60	3		2 5/7		2 6/7		3		3 1/7		3 2/7		3 3/7
70	3 1/2		3 1/7		3 2/7		3 3/7		4		3 5/7		4
80	4		3 4/7		3 6/7		4		4 2/7		4 3/7		4 4/7
90	4 1/2		4		4 2/7		4 3/7		4 5/7		4 6/7		5 1/7
100	5		4 4/7		4 5/7		5		5 2/7		5 3/7		5 5/7
200	10		9		9 4/7		10		10 4/7		11		11 3/7
300	15		13 4/7		14 2/7		15		15 5/7		16 3/7		17 1/7
400	20	1	1/7	1	1	1	2	1	3	1	3 6/7	1	4 6/7
500	25	1	4 4/7	1	5 6/7	1	7	1	8 1/7	1	9 3/7	1	10 4/7
600	30	1	9 1/7	1	10 4/7	1	12	1	13 3/7	1	14 6/7	1	16 2/7
700	35	1	13 5/7	1	15 2/7	1	17	2	5/7	2	2 2/7	2	4
800	40	2	1/7	2	2 1/7	2	4	2	5 6/7	2	7 6/7	2	9 5/7
900	45	2	4 5/7	2	6 6/7	2	9	2	11 1/7	2	13 2/7	2	15 3/7
1000	50	2	9 2/7	2	11 4/7	2	14	2	16 3/7	3	5/7	3	3 1/7
2000	100	5	3/7	5	5 2/7	5	10	5	14 5/7	6	1 4/7	6	6 2/7
3000	150	7	9 5/7	7	16 6/7	8	6	8	13 1/7	9	2 2/7	9	9 3/7
4000	200	10	1	10	10 3/7	11	2	11	11 4/7	12	3	12	12 4/7

Ells.		20		$20\frac{4}{5}$		$21\frac{3}{5}$		$22\frac{2}{5}$		$23\frac{1}{5}$		24	
Yards.		25		26		27		28		29		30	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$
5	$\frac{1}{4}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$
10	$\frac{1}{2}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$
20	1		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$
30	$1\frac{1}{2}$		$1\frac{5}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		2		2		$2\frac{1}{7}$
40	2		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{4}{7}$		$2\frac{5}{7}$		$2\frac{5}{7}$		$2\frac{6}{7}$
50	$2\frac{1}{2}$		3		$3\frac{1}{7}$		$3\frac{2}{7}$		$3\frac{3}{7}$		$3\frac{3}{7}$		$3\frac{4}{7}$
60	3		$3\frac{4}{7}$		$3\frac{5}{7}$		$3\frac{6}{7}$		4		$4\frac{1}{7}$		$4\frac{2}{7}$
70	$3\frac{1}{2}$		$4\frac{1}{7}$		$4\frac{2}{7}$		$4\frac{3}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$		5
80	4		$4\frac{6}{7}$		5		$5\frac{1}{7}$		$5\frac{3}{7}$		$5\frac{4}{7}$		$5\frac{5}{7}$
90	$4\frac{1}{2}$		$5\frac{2}{7}$		$5\frac{4}{7}$		$5\frac{5}{7}$		6		$6\frac{1}{7}$		$6\frac{3}{7}$
100	5		6		$6\frac{1}{7}$		$6\frac{3}{7}$		$6\frac{5}{7}$		$6\frac{6}{7}$		$7\frac{1}{7}$
200	10		12		$12\frac{3}{7}$		$12\frac{6}{7}$		$13\frac{3}{7}$		$13\frac{6}{7}$		$14\frac{2}{7}$
300	15		$17\frac{6}{7}$	1	$\frac{4}{7}$	1	$1\frac{2}{7}$	1	2	1	$2\frac{5}{7}$	1	$3\frac{3}{7}$
400	20	1	$5\frac{6}{7}$	1	$6\frac{5}{7}$	1	$7\frac{5}{7}$	1	$8\frac{5}{7}$	1	$9\frac{4}{7}$	1	$10\frac{4}{7}$
500	25	1	$11\frac{5}{7}$	1	13	1	$14\frac{1}{7}$	1	$15\frac{2}{7}$	1	$16\frac{4}{7}$	1	$17\frac{5}{7}$
600	30	1	$17\frac{5}{7}$	2	$1\frac{1}{7}$	2	$2\frac{4}{7}$	2	4	2	$5\frac{3}{7}$	2	$6\frac{6}{7}$
700	35	2	$5\frac{5}{7}$	2	$7\frac{2}{7}$	2	9	2	$10\frac{5}{7}$	2	$12\frac{2}{7}$	2	14
800	40	2	$11\frac{4}{7}$	2	$13\frac{4}{7}$	2	$15\frac{3}{7}$	2	$17\frac{2}{7}$	3	$1\frac{2}{7}$	3	$3\frac{1}{7}$
900	45	2	$17\frac{4}{7}$	3	$1\frac{5}{7}$	3	$4\frac{6}{7}$	3	6	3	$8\frac{1}{7}$	3	$10\frac{2}{7}$
1000	50	3	$5\frac{4}{7}$	3	$7\frac{6}{7}$	3	$10\frac{2}{7}$	3	$12\frac{5}{7}$	3	15	3	$17\frac{3}{7}$
2000	100	6	10	6	$15\frac{6}{7}$	7	$2\frac{4}{7}$	7	$7\frac{2}{7}$	7	$11\frac{1}{7}$	7	$16\frac{6}{7}$
3000	150	9	$16\frac{4}{7}$	10	$5\frac{5}{7}$	10	$12\frac{6}{7}$	11	2	11	$9\frac{1}{7}$	11	$16\frac{2}{7}$
4000	200	13	$4\frac{1}{7}$	13	$13\frac{4}{7}$	14	$5\frac{1}{7}$	14	$14\frac{5}{7}$	15	$6\frac{1}{7}$	15	$15\frac{5}{7}$

Ells.		$24\frac{4}{5}$		$25\frac{3}{5}$		$26\frac{2}{5}$		$27\frac{1}{5}$		28		$28\frac{4}{5}$	
Yards.		31		32		33		34		35		36	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$
5	$\frac{1}{4}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{3}{7}$
10	$\frac{1}{2}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$
20	1		$1\frac{3}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$
30	$1\frac{1}{2}$		$2\frac{1}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{4}{7}$
40	2		3		3		$3\frac{1}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{3}{7}$
50	$2\frac{1}{2}$		$3\frac{5}{7}$		$3\frac{6}{7}$		$3\frac{6}{7}$		4		$4\frac{1}{7}$		$4\frac{2}{7}$
60	3		$4\frac{3}{7}$		$4\frac{4}{7}$		$4\frac{5}{7}$		$4\frac{6}{7}$		5		$5\frac{1}{7}$
70	$3\frac{1}{2}$		$5\frac{1}{7}$		$5\frac{2}{7}$		$5\frac{3}{7}$		$5\frac{5}{7}$		$5\frac{6}{7}$		6
80	4		$5\frac{6}{7}$		$6\frac{1}{7}$		$6\frac{2}{7}$		$6\frac{3}{7}$		$6\frac{5}{7}$		$6\frac{6}{7}$
90	$4\frac{1}{2}$		$6\frac{4}{7}$		$6\frac{6}{7}$		7		$7\frac{2}{7}$		$7\frac{3}{7}$		$7\frac{5}{7}$
100	5		$7\frac{3}{7}$		$7\frac{4}{7}$		$7\frac{6}{7}$		$8\frac{1}{7}$		$8\frac{2}{7}$		$8\frac{4}{7}$
200	10		$14\frac{5}{7}$		$15\frac{2}{7}$		$15\frac{5}{7}$		$16\frac{1}{7}$		$16\frac{5}{7}$		$17\frac{1}{7}$
300	15	1	$4\frac{1}{7}$	1	$4\frac{6}{7}$	1	$5\frac{4}{7}$	1	$6\frac{2}{7}$	1	7	1	$7\frac{5}{7}$
400	20	1	$10\frac{6}{7}$	1	$12\frac{3}{7}$	1	$13\frac{3}{7}$	1	$14\frac{3}{7}$	1	$15\frac{2}{7}$	1	$16\frac{2}{7}$
500	25	2	$\frac{6}{7}$	2	$2\frac{1}{7}$	2	$3\frac{2}{7}$	2	$4\frac{3}{7}$	2	$5\frac{5}{7}$	2	$6\frac{6}{7}$
600	30	2	$8\frac{2}{7}$	2	$9\frac{5}{7}$	2	$11\frac{1}{7}$	2	$12\frac{4}{7}$	2	14	2	$15\frac{3}{7}$
700	35	2	$15\frac{5}{7}$	2	$17\frac{2}{7}$	3	1	3	$2\frac{5}{7}$	3	$4\frac{2}{7}$	3	6
800	40	3	5	3	7	3	$8\frac{6}{7}$	3	$10\frac{5}{7}$	3	$12\frac{5}{7}$	3	$14\frac{4}{7}$
900	45	3	$12\frac{3}{7}$	3	$14\frac{4}{7}$	3	$16\frac{5}{7}$	4	$\frac{6}{7}$	4	3	4	$5\frac{1}{7}$
1000	50	4	$1\frac{6}{7}$	4	$4\frac{1}{7}$	4	$6\frac{4}{7}$	4	9	4	$11\frac{2}{7}$	4	$13\frac{5}{7}$
2000	100	8	$3\frac{4}{7}$	8	$8\frac{3}{7}$	8	$13\frac{1}{7}$	8	$17\frac{6}{7}$	9	$4\frac{5}{7}$	9	$7\frac{3}{7}$
3000	150	12	$5\frac{3}{7}$	12	$12\frac{4}{7}$	13	$1\frac{5}{7}$	13	$8\frac{6}{7}$	13	16	14	$5\frac{1}{7}$
4000	200	16	$7\frac{2}{7}$	16	$16\frac{5}{7}$	17	$8\frac{2}{7}$	17	$17\frac{6}{7}$	18	$9\frac{2}{7}$	19	$\frac{6}{7}$

Ells.		$29\frac{3}{5}$		$30\frac{2}{5}$		$31\frac{1}{5}$		32		$32\frac{4}{5}$		$33\frac{3}{5}$	
Yards.		37		38		39		40		41		42	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{2}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$
5	$\frac{1}{4}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$
10	$\frac{1}{2}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		1		$1\frac{1}{7}$		$1\frac{1}{7}$
20	1		$1\frac{5}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		2
30	$1\frac{1}{2}$		$2\frac{4}{7}$		$2\frac{5}{7}$		$2\frac{5}{7}$		$2\frac{6}{7}$		$2\frac{6}{7}$		3
40	2		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{5}{7}$		$3\frac{6}{7}$		4		4
50	$2\frac{1}{2}$		$4\frac{3}{7}$		$4\frac{4}{7}$		$4\frac{4}{7}$		$4\frac{5}{7}$		$4\frac{6}{7}$		5
60	3		$5\frac{2}{7}$		$5\frac{3}{7}$		$5\frac{4}{7}$		$5\frac{5}{7}$		$5\frac{6}{7}$		6
70	$3\frac{1}{2}$		$6\frac{1}{7}$		$6\frac{2}{7}$		$6\frac{3}{7}$		$6\frac{5}{7}$		$6\frac{6}{7}$		7
80	4		7		$7\frac{2}{7}$		$7\frac{3}{7}$		$7\frac{4}{7}$		$7\frac{5}{7}$		8
90	$4\frac{1}{2}$		$7\frac{6}{7}$		$8\frac{1}{7}$		$8\frac{2}{7}$		$8\frac{4}{7}$		$8\frac{5}{7}$		9
100	5		$8\frac{6}{7}$		9		$9\frac{2}{7}$		$9\frac{4}{7}$		$9\frac{6}{7}$		10
200	10		$17\frac{4}{7}$	1	$\frac{1}{7}$	1	$\frac{4}{7}$	1	1	1	$1\frac{3}{7}$	1	2
300	15	1	$8\frac{3}{7}$	1	$9\frac{1}{7}$	1	$9\frac{6}{7}$	1	$10\frac{4}{7}$	1	$11\frac{2}{7}$	1	12
400	20	1	$17\frac{2}{7}$	2	$\frac{1}{7}$	2	$1\frac{1}{7}$	2	$2\frac{1}{7}$	2	$3\frac{6}{7}$	2	4
500	25	2	8	2	$9\frac{2}{7}$	2	$10\frac{3}{7}$	2	$11\frac{4}{7}$	2	$12\frac{5}{7}$	2	14
600	30	2	$16\frac{6}{7}$	3	$\frac{2}{7}$	3	$1\frac{5}{7}$	3	$3\frac{1}{7}$	3	$4\frac{4}{7}$	3	6
700	35	3	$7\frac{5}{7}$	3	$9\frac{2}{7}$	3	11	3	$12\frac{4}{7}$	3	$14\frac{2}{7}$	3	16
800	40	3	$16\frac{3}{7}$	4	$\frac{3}{7}$	4	$2\frac{2}{7}$	4	$4\frac{1}{7}$	4	6	4	8
900	45	4	$7\frac{2}{7}$	4	$9\frac{3}{7}$	4	$11\frac{4}{7}$	4	$13\frac{5}{7}$	4	$15\frac{6}{7}$	5	0
1000	50	4	$16\frac{1}{7}$	5	$\frac{3}{7}$	5	$2\frac{6}{7}$	5	$5\frac{2}{7}$	5	$7\frac{4}{7}$	5	10
2000	100	9	$14\frac{1}{7}$	10	1	10	$5\frac{5}{7}$	10	$10\frac{3}{7}$	10	$15\frac{2}{7}$	11	2
3000	150	14	$12\frac{2}{7}$	15	$1\frac{3}{7}$	15	$8\frac{4}{7}$	15	$15\frac{5}{7}$	16	$4\frac{6}{7}$	16	12
4000	200	19	$10\frac{3}{7}$	20	$1\frac{6}{7}$	20	$11\frac{3}{7}$	21	3	21	$12\frac{3}{7}$	22	4

Ells.		$34\frac{2}{5}$		$35\frac{1}{5}$		36		$36\frac{4}{5}$		$37\frac{3}{5}$		$38\frac{2}{5}$	
Yards.		43		44		45		46		47		48	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{4}{7}$
5	$\frac{1}{4}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{4}{7}$		$\frac{4}{7}$
10	$\frac{1}{2}$		1		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$
20	1		2		2		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{2}{7}$
30	$1\frac{1}{2}$		3		$3\frac{1}{7}$		$3\frac{1}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{3}{7}$
40	2		$4\frac{1}{7}$		$4\frac{2}{7}$		$4\frac{2}{7}$		$4\frac{3}{7}$		$4\frac{4}{7}$		$4\frac{4}{7}$
50	$2\frac{1}{2}$		5		$5\frac{1}{7}$		$5\frac{2}{7}$		$5\frac{3}{7}$		$5\frac{4}{7}$		$5\frac{5}{7}$
60	3		$6\frac{1}{7}$		$6\frac{2}{7}$		$6\frac{3}{7}$		$6\frac{4}{7}$		$6\frac{5}{7}$		$6\frac{6}{7}$
70	$3\frac{1}{2}$		$7\frac{1}{7}$		$7\frac{3}{7}$		$7\frac{4}{7}$		$7\frac{5}{7}$		$7\frac{6}{7}$		8
80	4		$8\frac{1}{7}$		$8\frac{2}{7}$		$8\frac{4}{7}$		$8\frac{5}{7}$		$8\frac{6}{7}$		$9\frac{1}{7}$
90	$4\frac{1}{2}$		$9\frac{1}{7}$		$9\frac{3}{7}$		$9\frac{4}{7}$		$9\frac{6}{7}$		10		$10\frac{2}{7}$
100	5		$10\frac{2}{7}$		$10\frac{4}{7}$		$10\frac{5}{7}$		11		$11\frac{1}{7}$		$11\frac{3}{7}$
200	10	1	$2\frac{3}{7}$	1	$2\frac{6}{7}$	1	$3\frac{3}{7}$	1	$3\frac{6}{7}$	1	$4\frac{2}{7}$	1	$4\frac{6}{7}$
300	15	1	$12\frac{5}{7}$	1	$13\frac{3}{7}$	1	$14\frac{1}{7}$	1	$14\frac{6}{7}$	1	$15\frac{4}{7}$	1	$16\frac{2}{7}$
400	20	2	5	2	$5\frac{6}{7}$	2	$6\frac{6}{7}$	2	$7\frac{6}{7}$	2	$8\frac{5}{7}$	2	$9\frac{5}{7}$
500	25	2	$15\frac{1}{7}$	2	$16\frac{2}{7}$	2	$17\frac{4}{7}$	3	$\frac{5}{7}$	3	$1\frac{6}{7}$	3	$3\frac{1}{7}$
600	30	3	$7\frac{3}{7}$	3	$8\frac{6}{7}$	3	$10\frac{2}{7}$	3	$11\frac{5}{7}$	3	$13\frac{1}{7}$	3	$14\frac{4}{7}$
700	35	3	$17\frac{5}{7}$	4	$1\frac{2}{7}$	4	3	4	$4\frac{5}{7}$	4	$6\frac{2}{7}$	4	8
800	40	4	$9\frac{6}{7}$	4	$11\frac{5}{7}$	4	$13\frac{5}{7}$	4	$15\frac{4}{7}$	4	$17\frac{3}{7}$	5	$1\frac{3}{7}$
900	45	5	$2\frac{1}{7}$	5	$4\frac{2}{7}$	5	$6\frac{3}{7}$	5	$8\frac{4}{7}$	5	$10\frac{5}{7}$	5	$12\frac{6}{7}$
1000	50	5	$12\frac{3}{7}$	5	$14\frac{5}{7}$	5	$17\frac{5}{7}$	6	$1\frac{1}{7}$	6	$3\frac{6}{7}$	6	$6\frac{2}{7}$
2000	100	11	$6\frac{5}{7}$	11	$11\frac{3}{7}$	11	$16\frac{2}{7}$	12	3	12	$7\frac{5}{7}$	12	$12\frac{4}{7}$
3000	150	17	$1\frac{1}{7}$	17	$8\frac{2}{7}$	17	$15\frac{3}{7}$	18	$4\frac{4}{7}$	18	$11\frac{5}{7}$	19	$\frac{6}{7}$
4000	200	22	$13\frac{4}{7}$	23	5	23	$14\frac{4}{7}$	24	6	24	$16\frac{4}{7}$	25	7

Ells.		$39\frac{1}{5}$		40		$40\frac{4}{5}$		$41\frac{3}{5}$		$42\frac{2}{5}$		$43\frac{1}{5}$	
Yards.		49		50		51		52		53		54	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$
5	$\frac{1}{4}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$
10	$\frac{1}{2}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{2}{7}$
20	1		$2\frac{2}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{4}{7}$		$2\frac{4}{7}$		$2\frac{4}{7}$
30	$1\frac{1}{2}$		$3\frac{3}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{5}{7}$		$3\frac{5}{7}$		$3\frac{6}{7}$
40	2		$4\frac{5}{7}$		$4\frac{5}{7}$		$4\frac{6}{7}$		$4\frac{6}{7}$		5		$5\frac{1}{7}$
50	$2\frac{1}{2}$		$5\frac{5}{7}$		6		$6\frac{1}{7}$		$6\frac{2}{7}$		$6\frac{2}{7}$		$6\frac{3}{7}$
60	3		7		$7\frac{1}{7}$		$7\frac{2}{7}$		$7\frac{3}{7}$		$7\frac{4}{7}$		$7\frac{5}{7}$
70	$3\frac{1}{2}$		$8\frac{1}{7}$		$8\frac{2}{7}$		$8\frac{3}{7}$		$8\frac{4}{7}$		$8\frac{5}{7}$		9
80	4		$9\frac{2}{7}$		$9\frac{4}{7}$		$9\frac{5}{7}$		10		$10\frac{1}{7}$		$10\frac{2}{7}$
90	$4\frac{1}{2}$		$10\frac{2}{7}$		$10\frac{5}{7}$		$10\frac{6}{7}$		$11\frac{1}{7}$		$11\frac{2}{7}$		$11\frac{4}{7}$
100	5		$11\frac{5}{7}$		$11\frac{6}{7}$		$12\frac{1}{7}$		$12\frac{2}{7}$		$12\frac{4}{7}$		$12\frac{6}{7}$
200	10	1	$5\frac{2}{7}$	1	$5\frac{6}{7}$	1	$6\frac{1}{7}$	1	$6\frac{5}{7}$	1	$7\frac{2}{7}$	1	$7\frac{5}{7}$
300	15	1	17	1	$17\frac{5}{7}$	2	$\frac{3}{7}$	2	$1\frac{1}{7}$	2	$1\frac{6}{7}$	2	$2\frac{3}{7}$
400	20	2	$10\frac{5}{7}$	2	$11\frac{4}{7}$	2	$12\frac{4}{7}$	2	$13\frac{3}{7}$	2	$14\frac{1}{7}$	2	$15\frac{3}{7}$
500	25	3	$4\frac{2}{7}$	3	$5\frac{4}{7}$	3	$6\frac{5}{7}$	3	$7\frac{6}{7}$	3	$9\frac{1}{7}$	3	$10\frac{2}{7}$
600	30	3	16	3	$17\frac{3}{7}$	4	$\frac{6}{7}$	4	$2\frac{2}{7}$	4	$3\frac{5}{7}$	4	$5\frac{1}{7}$
700	35	4	$9\frac{5}{7}$	4	$11\frac{2}{7}$	4	13	4	$14\frac{4}{7}$	4	$16\frac{4}{7}$	5	0
800	40	5	$3\frac{2}{7}$	5	$5\frac{2}{7}$	5	$7\frac{1}{7}$	5	9	5	11	5	$12\frac{6}{7}$
900	45	5	15	5	$17\frac{1}{7}$	6	$1\frac{2}{7}$	6	$3\frac{3}{7}$	6	$5\frac{4}{7}$	6	$7\frac{5}{7}$
1000	50	6	$8\frac{5}{7}$	6	11	6	$13\frac{3}{7}$	6	$15\frac{5}{7}$	7	$\frac{1}{7}$	7	$2\frac{4}{7}$
2000	100	12	$17\frac{2}{7}$	13	$4\frac{1}{7}$	13	$8\frac{6}{7}$	13	$13\frac{4}{7}$	14	$\frac{3}{7}$	14	$5\frac{1}{7}$
3000	150	19	8	19	$15\frac{1}{7}$	20	$4\frac{2}{7}$	20	$11\frac{3}{7}$	21	$\frac{4}{7}$	21	$7\frac{5}{7}$
4000	200	25	$16\frac{5}{7}$	26	$8\frac{1}{7}$	26	$17\frac{5}{7}$	27	$9\frac{1}{7}$	28	$\frac{5}{7}$	28	$10\frac{2}{7}$

Ells.		44		$44\frac{4}{5}$		$45\frac{3}{5}$		$46\frac{2}{5}$		$47\frac{1}{5}$		48	
Yards.		55		56		57		58		59		60	
Splits.	Portei s.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{3}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$
5	$\frac{1}{4}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$
10	$\frac{1}{2}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{3}{7}$
20	1		$2\frac{5}{7}$		$2\frac{5}{7}$		$2\frac{5}{7}$		$2\frac{6}{7}$		$2\frac{6}{7}$		$2\frac{6}{7}$
30	$1\frac{1}{2}$		$3\frac{6}{7}$		4		4		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{2}{7}$
40	2		$5\frac{1}{7}$		$5\frac{2}{7}$		$5\frac{3}{7}$		$5\frac{3}{7}$		$5\frac{4}{7}$		$5\frac{5}{7}$
50	$2\frac{1}{2}$		$6\frac{4}{7}$		$6\frac{5}{7}$		$6\frac{6}{7}$		7		7		$7\frac{1}{7}$
60	3		$7\frac{6}{7}$		8		$8\frac{1}{7}$		$8\frac{2}{7}$		$8\frac{3}{7}$		$8\frac{4}{7}$
70	$3\frac{1}{2}$		$9\frac{1}{7}$		$9\frac{2}{7}$		$9\frac{3}{7}$		$9\frac{4}{7}$		$9\frac{5}{7}$		10
80	4		$10\frac{4}{7}$		$10\frac{5}{7}$		$10\frac{6}{7}$		$11\frac{1}{7}$		$11\frac{2}{7}$		$11\frac{3}{7}$
90	$4\frac{1}{2}$		$11\frac{5}{7}$		12		$12\frac{1}{7}$		$12\frac{3}{7}$		$12\frac{4}{7}$		$12\frac{6}{7}$
100	5		13		$13\frac{2}{7}$		$13\frac{4}{7}$		$13\frac{5}{7}$		14		$14\frac{2}{7}$
200	10	1	$4\frac{1}{7}$	1	$8\frac{5}{7}$	1	$9\frac{1}{7}$	1	$9\frac{4}{7}$	1	$10\frac{1}{7}$	1	$10\frac{4}{7}$
300	15	2	$3\frac{2}{7}$	2	4	2	$4\frac{5}{7}$	2	$5\frac{3}{7}$	2	$6\frac{1}{7}$	2	$6\frac{6}{7}$
400	20	2	$16\frac{2}{7}$	2	$17\frac{2}{7}$	3	$\frac{2}{7}$	3	$1\frac{1}{7}$	3	$2\frac{1}{7}$	3	$3\frac{1}{7}$
500	25	3	$11\frac{3}{7}$	3	$12\frac{5}{7}$	3	$13\frac{6}{7}$	3	15	3	$16\frac{2}{7}$	3	$17\frac{3}{7}$
600	30	4	$6\frac{4}{7}$	4	8	4	$9\frac{3}{7}$	4	$10\frac{6}{7}$	4	$12\frac{2}{7}$	4	$13\frac{3}{7}$
700	35	5	$1\frac{4}{7}$	5	$3\frac{2}{7}$	5	5	5	$6\frac{4}{7}$	5	$8\frac{2}{7}$	5	10
800	40	5	$14\frac{5}{7}$	5	$16\frac{5}{7}$	6	$\frac{4}{7}$	6	$2\frac{3}{7}$	6	$4\frac{3}{7}$	6	$6\frac{2}{7}$
900	45	6	$9\frac{6}{7}$	6	12	6	$14\frac{1}{7}$	6	$16\frac{2}{7}$	7	$\frac{3}{7}$	7	$2\frac{4}{7}$
1000	50	7	$4\frac{6}{7}$	7	$7\frac{2}{7}$	7	$9\frac{5}{7}$	7	12	7	$14\frac{3}{7}$	7	$16\frac{6}{7}$
2000	100	14	$9\frac{6}{7}$	14	$14\frac{5}{7}$	15	$1\frac{3}{7}$	15	$6\frac{1}{7}$	15	11	15	$15\frac{5}{7}$
3000	150	21	$14\frac{6}{7}$	22	4	22	$11\frac{1}{7}$	23	$\frac{2}{7}$	23	$7\frac{3}{7}$	23	$14\frac{4}{7}$
4000	200	29	$1\frac{5}{7}$	29	$11\frac{2}{7}$	30	$2\frac{6}{7}$	30	$12\frac{2}{7}$	31	$3\frac{6}{7}$	31	$13\frac{3}{7}$

Ells.		$48\frac{4}{5}$		$49\frac{3}{5}$		$50\frac{2}{5}$		$51\frac{1}{5}$		52		$52\frac{4}{5}$	
Yards.		61		62		63		64		65		66	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$		$\frac{4}{7}$
5	$\frac{1}{4}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$
10	$\frac{1}{2}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$
20	1		$2\frac{6}{7}$		3		3		3		$3\frac{1}{7}$		$3\frac{1}{7}$
30	$1\frac{1}{2}$		$4\frac{2}{7}$		$4\frac{3}{7}$		$4\frac{3}{7}$		$4\frac{4}{7}$		$4\frac{4}{7}$		$4\frac{5}{7}$
40	2		$5\frac{6}{7}$		$5\frac{6}{7}$		6		$6\frac{1}{7}$		$6\frac{1}{7}$		$6\frac{2}{7}$
50	$2\frac{1}{2}$		$7\frac{2}{7}$		$7\frac{3}{7}$		$7\frac{3}{7}$		$7\frac{4}{7}$		$7\frac{5}{7}$		$7\frac{6}{7}$
60	3		$8\frac{5}{7}$		$8\frac{6}{7}$		9		$9\frac{1}{7}$		$9\frac{2}{7}$		$9\frac{3}{7}$
70	$3\frac{1}{2}$		$10\frac{1}{7}$		$10\frac{2}{7}$		$10\frac{3}{7}$		$10\frac{5}{7}$		$10\frac{6}{7}$		11
80	4		$11\frac{4}{7}$		$11\frac{6}{7}$		12		$12\frac{1}{7}$		$12\frac{3}{7}$		$12\frac{4}{7}$
90	$4\frac{1}{2}$		13		$13\frac{2}{7}$		$13\frac{3}{7}$		$13\frac{5}{7}$		$13\frac{6}{7}$		$14\frac{1}{7}$
100	5		$14\frac{4}{7}$		$14\frac{5}{7}$		15		$15\frac{2}{7}$		$15\frac{3}{7}$		$15\frac{5}{7}$
200	10	1	11	1	$11\frac{4}{7}$	1	12	1	$12\frac{3}{7}$	1	13	1	$13\frac{3}{7}$
300	15	2	$7\frac{4}{7}$	2	$8\frac{2}{7}$	2	9	2	$9\frac{5}{7}$	2	$10\frac{3}{7}$	2	$11\frac{1}{7}$
400	20	3	$4\frac{1}{7}$	3	5	3	6	3	7	3	$7\frac{6}{7}$	3	$8\frac{6}{7}$
500	25	4	$\frac{4}{7}$	4	$1\frac{6}{7}$	4	3	4	$4\frac{1}{7}$	4	$5\frac{3}{7}$	4	$6\frac{4}{7}$
600	30	4	$15\frac{1}{7}$	4	$16\frac{4}{7}$	5	0	5	$1\frac{3}{7}$	5	$2\frac{6}{7}$	5	$4\frac{2}{7}$
700	35	5	$11\frac{5}{7}$	5	$13\frac{2}{7}$	5	15	5	$16\frac{5}{7}$	6	$\frac{2}{7}$	6	2
800	40	6	$8\frac{1}{7}$	6	$10\frac{1}{7}$	6	12	6	$13\frac{6}{7}$	6	$15\frac{6}{7}$	6	$17\frac{5}{7}$
900	45	7	$4\frac{5}{7}$	7	$6\frac{6}{7}$	7	9	7	$11\frac{1}{7}$	7	$13\frac{2}{7}$	7	$15\frac{3}{7}$
1000	50	8	$1\frac{2}{7}$	8	$3\frac{4}{7}$	8	6	8	$8\frac{3}{7}$	8	$10\frac{3}{7}$	8	$13\frac{1}{7}$
2000	100	16	$2\frac{3}{7}$	16	$7\frac{2}{7}$	16	12	16	$16\frac{5}{7}$	17	$3\frac{4}{7}$	17	$8\frac{2}{7}$
3000	150	24	$3\frac{5}{7}$	24	$10\frac{6}{7}$	25	0	25	$7\frac{1}{7}$	25	$14\frac{2}{7}$	26	$3\frac{3}{7}$
4000	200	32	5	32	$14\frac{3}{7}$	33	$6\frac{4}{7}$	34	$5\frac{1}{7}$	34	7	34	$16\frac{4}{7}$

Ells.		$53\frac{3}{5}$		$54\frac{2}{5}$		$55\frac{1}{5}$		56		$56\frac{4}{5}$		$57\frac{3}{5}$	
Yards.		67		68		69		70		71		72	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{4}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$
5	$\frac{1}{4}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$
10	$\frac{1}{2}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$
20	1		$3\frac{1}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{3}{7}$
30	$1\frac{1}{2}$		$4\frac{5}{7}$		$4\frac{6}{7}$		$4\frac{6}{7}$		5		5		6
40	2		$6\frac{3}{7}$		$6\frac{3}{7}$		$6\frac{4}{7}$		$6\frac{5}{7}$		$6\frac{6}{7}$		$6\frac{6}{7}$
50	$2\frac{1}{2}$		8		$8\frac{1}{7}$		$8\frac{1}{7}$		$8\frac{2}{7}$		$8\frac{3}{7}$		$8\frac{4}{7}$
60	3		$9\frac{5}{7}$		$9\frac{5}{7}$		$9\frac{6}{7}$		10		$10\frac{1}{7}$		$10\frac{2}{7}$
70	$3\frac{1}{2}$		$11\frac{1}{7}$		$11\frac{2}{7}$		$11\frac{3}{7}$		$11\frac{5}{7}$		$11\frac{6}{7}$		12
80	4		$12\frac{5}{7}$		13		$13\frac{1}{7}$		$13\frac{2}{7}$		$13\frac{3}{7}$		$13\frac{5}{7}$
90	$4\frac{1}{2}$		$14\frac{2}{7}$		$14\frac{4}{7}$		$14\frac{5}{7}$		15		$15\frac{1}{7}$		$15\frac{3}{7}$
100	5		16		$16\frac{1}{7}$		$16\frac{3}{7}$		$16\frac{5}{7}$		17		$17\frac{1}{7}$
200	10	1	$13\frac{6}{7}$	1	$14\frac{3}{7}$	1	$14\frac{6}{7}$	1	$15\frac{2}{7}$	1	$15\frac{5}{7}$	1	$16\frac{2}{7}$
300	15	2	$11\frac{6}{7}$	2	$12\frac{4}{7}$	2	$13\frac{2}{7}$	2	14	2	$14\frac{5}{7}$	2	$15\frac{3}{7}$
400	20	3	$9\frac{6}{7}$	3	$10\frac{5}{7}$	3	$11\frac{5}{7}$	3	$12\frac{5}{7}$	3	$13\frac{4}{7}$	3	$14\frac{4}{7}$
500	25	4	$7\frac{5}{7}$	4	9	4	$10\frac{1}{7}$	4	$11\frac{2}{7}$	4	$12\frac{3}{7}$	4	$13\frac{5}{7}$
600	30	5	$5\frac{5}{7}$	5	$7\frac{1}{7}$	5	$8\frac{4}{7}$	5	10	5	$11\frac{3}{7}$	5	$12\frac{6}{7}$
700	35	6	$3\frac{5}{7}$	6	$5\frac{2}{7}$	6	7	6	$8\frac{5}{7}$	6	$10\frac{2}{7}$	6	12
800	40	7	$1\frac{4}{7}$	7	$3\frac{4}{7}$	7	$5\frac{3}{7}$	7	$7\frac{2}{7}$	7	$9\frac{1}{7}$	7	$11\frac{1}{7}$
900	45	7	$17\frac{4}{7}$	8	$1\frac{5}{7}$	8	$3\frac{6}{7}$	8	6	8	$8\frac{1}{7}$	8	$10\frac{2}{7}$
1000	50	8	$15\frac{4}{7}$	8	$17\frac{6}{7}$	9	$2\frac{2}{7}$	9	$4\frac{5}{7}$	9	7	9	$9\frac{2}{7}$
2000	100	17	13	17	$17\frac{6}{7}$	18	$4\frac{4}{7}$	18	$9\frac{2}{7}$	18	14	19	$\frac{6}{7}$
3000	150	26	$10\frac{4}{7}$	26	$17\frac{5}{7}$	27	$6\frac{6}{7}$	27	14	28	$3\frac{1}{7}$	28	$10\frac{2}{7}$
4000	200	35	$8\frac{1}{7}$	35	$17\frac{4}{7}$	36	$9\frac{1}{7}$	37	0	37	$9\frac{3}{7}$	38	$1\frac{5}{7}$

Ells.		$58\frac{2}{5}$		$59\frac{1}{5}$		60		$60\frac{4}{5}$		$61\frac{3}{5}$		$62\frac{2}{5}$	
Yards.		73		74		75		76		77		78	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$
5	$\frac{1}{4}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		1		1
10	$\frac{1}{2}$		$1\frac{5}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$
20	1		$3\frac{3}{7}$		$3\frac{3}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{5}{7}$
30	$1\frac{1}{2}$		$5\frac{1}{7}$		$5\frac{2}{7}$		$5\frac{2}{7}$		$5\frac{3}{7}$		$5\frac{3}{7}$		$5\frac{4}{7}$
40	2		7		$7\frac{1}{7}$		$7\frac{1}{7}$		$7\frac{2}{7}$		$7\frac{3}{7}$		$7\frac{3}{7}$
50	$2\frac{1}{2}$		$8\frac{4}{7}$		$8\frac{5}{7}$		$8\frac{6}{7}$		9		$9\frac{1}{7}$		$9\frac{2}{7}$
60	3		$10\frac{3}{7}$		$10\frac{4}{7}$		$10\frac{5}{7}$		$10\frac{6}{7}$		11		$11\frac{1}{7}$
70	$3\frac{1}{2}$		$12\frac{1}{7}$		$12\frac{3}{7}$		$12\frac{4}{7}$		$12\frac{5}{7}$		$12\frac{6}{7}$		13
80	4		$13\frac{6}{7}$		14		$14\frac{2}{7}$		$14\frac{3}{7}$		$14\frac{4}{7}$		$14\frac{6}{7}$
90	$4\frac{1}{2}$		$15\frac{4}{7}$		$15\frac{6}{7}$		16		$16\frac{2}{7}$		$16\frac{3}{7}$		$16\frac{5}{7}$
100	5		$17\frac{3}{7}$		$17\frac{5}{7}$		$17\frac{6}{7}$	1	$\frac{1}{7}$	1	$\frac{3}{7}$	1	$\frac{4}{7}$
200	10	1	$16\frac{5}{7}$	1	$17\frac{1}{7}$	1	$17\frac{5}{7}$	2	$\frac{1}{7}$	2	$\frac{4}{7}$	2	$1\frac{1}{7}$
300	15	2	$16\frac{1}{7}$	2	$16\frac{6}{7}$	2	$17\frac{4}{7}$	3	$\frac{2}{7}$	3	1	3	$1\frac{5}{7}$
400	20	3	$15\frac{3}{7}$	3	$16\frac{3}{7}$	3	$17\frac{3}{7}$	4	$\frac{3}{7}$	4	$1\frac{2}{7}$	4	$2\frac{2}{7}$
500	25	4	$14\frac{6}{7}$	4	16	4	$17\frac{2}{7}$	5	$\frac{3}{7}$	5	$1\frac{4}{7}$	5	$2\frac{6}{7}$
600	30	5	$14\frac{2}{7}$	5	$15\frac{5}{7}$	5	$17\frac{1}{7}$	6	$\frac{4}{7}$	6	2	6	$3\frac{3}{7}$
700	35	6	$13\frac{5}{7}$	6	$15\frac{2}{7}$	6	17	7	$\frac{5}{7}$	7	$2\frac{2}{7}$	7	4
800	40	7	13	7	$14\frac{6}{7}$	7	$16\frac{6}{7}$	8	$\frac{5}{7}$	8	$2\frac{4}{7}$	8	$4\frac{4}{7}$
900	45	8	$12\frac{3}{7}$	8	$14\frac{4}{7}$	8	$16\frac{5}{7}$	9	$\frac{6}{7}$	9	3	9	$5\frac{1}{7}$
1000	50	9	$11\frac{6}{7}$	9	$14\frac{1}{7}$	9	$16\frac{4}{7}$	10	1	10	$3\frac{2}{7}$	10	$5\frac{5}{7}$
2000	100	19	$5\frac{4}{7}$	19	$10\frac{2}{7}$	19	$15\frac{1}{7}$	20	$1\frac{6}{7}$	20	$6\frac{4}{7}$	20	$11\frac{3}{7}$
3000	150	28	$17\frac{3}{7}$	29	$6\frac{4}{7}$	29	$13\frac{5}{7}$	30	$2\frac{6}{7}$	30	10	30	$17\frac{1}{7}$
4000	200	38	$11\frac{2}{7}$	39	$2\frac{5}{7}$	39	$12\frac{2}{7}$	40	$3\frac{6}{7}$	40	$13\frac{2}{7}$	41	$4\frac{6}{7}$

Ells.		$63\frac{1}{5}$		64	
Yards.		79		80	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$				
4	$\frac{1}{5}$		$\frac{5}{7}$		$\frac{5}{7}$
5	$\frac{1}{4}$		1		1
10	$\frac{1}{2}$		$1\frac{6}{7}$		$1\frac{6}{7}$
20	1		$3\frac{5}{7}$		$3\frac{6}{7}$
30	$1\frac{1}{2}$		$5\frac{4}{7}$		$5\frac{5}{7}$
40	2		$7\frac{4}{7}$		$7\frac{4}{7}$
50	$2\frac{1}{2}$		$9\frac{2}{7}$		$9\frac{4}{7}$
60	3		$11\frac{2}{7}$		$11\frac{3}{7}$
70	$3\frac{1}{2}$		$13\frac{1}{7}$		$13\frac{2}{7}$
80	4		15		$15\frac{2}{7}$
90	$4\frac{1}{2}$		$16\frac{6}{7}$		$17\frac{1}{7}$
100	5	1	$\frac{6}{7}$	1	1
200	10	2	$1\frac{4}{7}$	2	$2\frac{1}{7}$
300	15	3	$2\frac{3}{7}$	3	$3\frac{1}{7}$
400	20	4	$3\frac{2}{7}$	4	$4\frac{1}{7}$
500	25	5	4	5	$5\frac{2}{7}$
600	30	6	$4\frac{6}{7}$	6	$6\frac{2}{7}$
700	35	7	$5\frac{5}{7}$	7	$7\frac{2}{7}$
800	40	8	$6\frac{2}{7}$	8	$8\frac{2}{7}$
900	45	9	$7\frac{2}{7}$	9	$9\frac{3}{7}$
1000	50	10	$8\frac{1}{7}$	10	$10\frac{3}{7}$
2000	100	20	$16\frac{1}{7}$	21	3
3000	150	31	$6\frac{2}{7}$	31	$13\frac{3}{7}$
4000	200	41	$14\frac{3}{7}$	42	$5\frac{6}{7}$

Ells.		$64\frac{4}{5}$		$65\frac{3}{5}$	
Yards.		81		82	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$				
4	$\frac{1}{5}$		$\frac{5}{7}$		$\frac{5}{7}$
5	$\frac{1}{4}$		1		1
10	$\frac{1}{2}$		$1\frac{6}{7}$		$1\frac{6}{7}$
20	1		$3\frac{6}{7}$		4
30	$1\frac{1}{2}$		$5\frac{5}{7}$		$5\frac{6}{7}$
40	2		$7\frac{5}{7}$		$7\frac{5}{7}$
50	$2\frac{1}{2}$		$9\frac{5}{7}$		$9\frac{6}{7}$
60	3		$11\frac{4}{7}$		$11\frac{5}{7}$
70	$3\frac{1}{2}$		$13\frac{3}{7}$		$13\frac{4}{7}$
80	4		$15\frac{3}{7}$		$15\frac{5}{7}$
90	$4\frac{1}{2}$		$17\frac{2}{7}$		$17\frac{4}{7}$
100	5	1	$1\frac{2}{7}$	1	$1\frac{3}{7}$
200	10	2	$2\frac{4}{7}$	2	3
300	15	3	$3\frac{6}{7}$	3	$4\frac{4}{7}$
400	20	4	$5\frac{1}{7}$	4	6
500	25	5	$6\frac{3}{7}$	5	$7\frac{4}{7}$
600	30	6	$7\frac{5}{7}$	6	$9\frac{1}{7}$
700	35	7	9	7	$10\frac{4}{7}$
800	40	8	$10\frac{2}{7}$	8	$12\frac{1}{7}$
900	45	9	$11\frac{4}{7}$	9	$13\frac{5}{7}$
1000	50	10	$12\frac{6}{7}$	10	$15\frac{1}{7}$
2000	100	21	$7\frac{5}{7}$	21	$12\frac{3}{7}$
3000	150	32	$2\frac{4}{7}$	32	$9\frac{5}{7}$
4000	200	42	$15\frac{3}{7}$	43	$6\frac{6}{7}$

Ells.		$66\frac{2}{5}$		$67\frac{1}{5}$	
Yards.		83		84	
Splits.	Porters.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$				
4	$\frac{1}{5}$		$\frac{5}{7}$		$\frac{5}{7}$
5	$\frac{1}{4}$		1		1
10	$\frac{1}{2}$		$1\frac{6}{7}$		2
20	1		4		4
30	$1\frac{1}{2}$		6		6
40	2		$7\frac{6}{7}$		8
50	$2\frac{1}{2}$		$9\frac{6}{7}$		10
60	3		$11\frac{6}{7}$		12
70	$3\frac{1}{2}$		$13\frac{5}{7}$		14
80	4		$15\frac{6}{7}$		16
90	$4\frac{1}{2}$		$17\frac{5}{7}$	1	0
100	5	1	$1\frac{5}{7}$	1	2
200	10	2	$3\frac{4}{7}$	2	4
300	15	3	$5\frac{2}{7}$	3	6
400	20	4	7	4	8
500	25	5	$8\frac{6}{7}$	5	10
600	30	6	$10\frac{4}{7}$	6	12
700	35	7	$12\frac{2}{7}$	7	14
800	40	8	$14\frac{1}{7}$	8	16
900	45	9	$15\frac{6}{7}$	10	0
1000	50	10	$17\frac{4}{7}$	11	2
2000	100	21	$17\frac{2}{7}$	22	4
3000	150	32	$16\frac{6}{7}$	33	6
4000	200	43	$16\frac{3}{7}$	44	8

Ells.		68		$68\frac{4}{5}$		$69\frac{3}{5}$		$70\frac{2}{5}$		$71\frac{1}{5}$		72	
Yards.		85		86		87		88		89		90	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$
5	$\frac{1}{4}$		1		1		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$
10	$\frac{1}{2}$		2		2		2		2		2		$2\frac{1}{7}$
20	1		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{2}{7}$		$4\frac{2}{7}$		$4\frac{2}{7}$
30	$1\frac{1}{2}$		6		$6\frac{1}{7}$		$6\frac{1}{7}$		$6\frac{2}{7}$		$6\frac{2}{7}$		$6\frac{3}{7}$
40	2		8		$8\frac{1}{7}$		$8\frac{2}{7}$		$8\frac{2}{7}$		$8\frac{3}{7}$		$8\frac{4}{7}$
50	$2\frac{1}{2}$		$10\frac{1}{7}$		$10\frac{2}{7}$		$10\frac{3}{7}$		$10\frac{4}{7}$		$10\frac{4}{7}$		$10\frac{5}{7}$
60	3		$12\frac{1}{7}$		$12\frac{2}{7}$		$12\frac{3}{7}$		$12\frac{4}{7}$		$12\frac{5}{7}$		$12\frac{6}{7}$
70	$3\frac{1}{2}$		$14\frac{1}{7}$		$14\frac{2}{7}$		$14\frac{3}{7}$		$14\frac{4}{7}$		$14\frac{5}{7}$		15
80	4		$16\frac{2}{7}$		$16\frac{3}{7}$		$16\frac{4}{7}$		$16\frac{6}{7}$		17		$17\frac{1}{7}$
90	$4\frac{1}{2}$	1	$\frac{1}{7}$	1	$\frac{3}{7}$	1	$\frac{4}{7}$	1	$\frac{6}{7}$	1	1	1	$1\frac{2}{7}$
100	5	1	$2\frac{1}{7}$	1	$2\frac{3}{7}$	1	$2\frac{5}{7}$	1	$2\frac{6}{7}$	1	$3\frac{1}{7}$	1	$3\frac{3}{7}$
200	10	2	$4\frac{3}{7}$	2	5	2	$5\frac{3}{7}$	2	$5\frac{6}{7}$	2	$6\frac{3}{7}$	2	$6\frac{6}{7}$
300	15	3	$6\frac{5}{7}$	3	$7\frac{3}{7}$	3	$8\frac{1}{7}$	3	$8\frac{6}{7}$	3	$9\frac{4}{7}$	3	$10\frac{2}{7}$
400	20	4	$8\frac{6}{7}$	4	$9\frac{6}{7}$	4	$10\frac{6}{7}$	4	$11\frac{5}{7}$	4	$12\frac{5}{7}$	4	$13\frac{5}{7}$
500	25	5	$11\frac{1}{7}$	5	$12\frac{3}{7}$	5	$13\frac{4}{7}$	5	$14\frac{5}{7}$	5	16	5	$17\frac{1}{7}$
600	30	6	$13\frac{3}{7}$	6	$14\frac{6}{7}$	6	$16\frac{2}{7}$	6	$17\frac{5}{7}$	7	$1\frac{1}{7}$	7	$2\frac{4}{7}$
700	35	7	$15\frac{4}{7}$	7	$17\frac{2}{7}$	8	1	8	$2\frac{4}{7}$	8	$4\frac{2}{7}$	8	6
800	40	8	$17\frac{6}{7}$	9	$1\frac{6}{7}$	9	$3\frac{5}{7}$	9	$5\frac{4}{7}$	9	$7\frac{4}{7}$	9	$9\frac{3}{7}$
900	45	10	$2\frac{1}{7}$	10	$4\frac{2}{7}$	10	$6\frac{3}{7}$	10	$8\frac{4}{7}$	10	$10\frac{5}{7}$	10	$12\frac{6}{7}$
1000	50	11	$4\frac{2}{7}$	11	$6\frac{5}{7}$	11	$9\frac{1}{7}$	11	$11\frac{3}{7}$	11	$13\frac{6}{7}$	11	$16\frac{2}{7}$
2000	100	22	$8\frac{5}{7}$	22	$13\frac{4}{7}$	23	$\frac{2}{7}$	23	$5\frac{5}{7}$	23	$9\frac{6}{7}$	23	$14\frac{4}{7}$
3000	150	33	$13\frac{1}{7}$	34	$2\frac{2}{7}$	34	$9\frac{3}{7}$	34	$16\frac{4}{7}$	35	$5\frac{5}{7}$	35	$12\frac{6}{7}$
4000	200	44	$17\frac{3}{7}$	45	9	46	$\frac{4}{7}$	46	10	47	$1\frac{4}{7}$	47	$11\frac{1}{7}$

Ells.		$72\frac{4}{5}$		$73\frac{3}{5}$		$74\frac{2}{5}$		$75\frac{1}{5}$		76		$76\frac{4}{5}$	
Yards.		91		92		93		94		95		96	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$		$\frac{6}{7}$
5	$\frac{1}{4}$		1		1		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$
10	$\frac{1}{2}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$
20	1		$4\frac{2}{7}$		$4\frac{3}{7}$		$4\frac{3}{7}$		$4\frac{3}{7}$		$4\frac{4}{7}$		$4\frac{4}{7}$
30	$1\frac{1}{2}$		$6\frac{3}{7}$		$6\frac{4}{7}$		$6\frac{4}{7}$		$6\frac{5}{7}$		$6\frac{5}{7}$		$6\frac{6}{7}$
40	2		$8\frac{5}{7}$		$8\frac{5}{7}$		$8\frac{6}{7}$		9		9		$9\frac{1}{7}$
50	$2\frac{1}{2}$		$10\frac{6}{7}$		11		11		$11\frac{1}{7}$		$11\frac{2}{7}$		$11\frac{3}{7}$
60	3		13		$13\frac{1}{7}$		$13\frac{2}{7}$		$13\frac{3}{7}$		$13\frac{4}{7}$		$13\frac{5}{7}$
70	$3\frac{1}{2}$		$15\frac{1}{7}$		$15\frac{2}{7}$		$15\frac{3}{7}$		$15\frac{5}{7}$		$15\frac{6}{7}$		16
80	4		$17\frac{2}{7}$		$17\frac{4}{7}$		$17\frac{5}{7}$		$17\frac{6}{7}$	1	$\frac{1}{7}$	1	$\frac{2}{7}$
90	$4\frac{1}{2}$	1	$1\frac{3}{7}$	1	$1\frac{5}{7}$	1	$1\frac{6}{7}$	1	$2\frac{1}{7}$	1	$2\frac{2}{7}$	1	$2\frac{4}{7}$
100	5	1	$3\frac{5}{7}$	1	$3\frac{6}{7}$	1	$4\frac{1}{7}$	1	$4\frac{3}{7}$	1	$4\frac{4}{7}$	1	$4\frac{6}{7}$
200	10	2	$7\frac{2}{7}$	2	$7\frac{6}{7}$	2	$8\frac{2}{7}$	2	$8\frac{5}{7}$	2	$9\frac{2}{7}$	2	$9\frac{5}{7}$
300	15	3	11	3	$11\frac{5}{7}$	3	$12\frac{3}{7}$	3	$13\frac{1}{7}$	3	$13\frac{6}{7}$	3	$14\frac{4}{7}$
400	20	4	$14\frac{5}{7}$	4	$15\frac{4}{7}$	4	$16\frac{4}{7}$	4	$17\frac{4}{7}$	5	$\frac{3}{7}$	5	$1\frac{3}{7}$
500	25	6	$\frac{2}{7}$	6	$1\frac{4}{7}$	6	$2\frac{5}{7}$	6	$3\frac{6}{7}$	6	$5\frac{1}{7}$	6	$6\frac{2}{7}$
600	30	7	4	7	$5\frac{3}{7}$	7	$6\frac{6}{7}$	7	$8\frac{2}{7}$	7	$9\frac{5}{7}$	7	$11\frac{1}{7}$
700	35	8	$7\frac{5}{7}$	8	$9\frac{2}{7}$	8	11	8	$12\frac{5}{7}$	8	$14\frac{2}{7}$	8	16
800	40	9	$11\frac{2}{7}$	9	$13\frac{2}{7}$	9	$15\frac{1}{7}$	9	17	10	1	10	$2\frac{6}{7}$
900	45	10	15	10	$17\frac{1}{7}$	11	$1\frac{2}{7}$	11	$3\frac{3}{7}$	11	$5\frac{4}{7}$	11	$7\frac{5}{7}$
1000	50	12	$\frac{5}{7}$	12	3	12	$5\frac{3}{7}$	12	$7\frac{6}{7}$	12	$10\frac{1}{7}$	12	$12\frac{4}{7}$
2000	100	24	$1\frac{2}{7}$	24	$6\frac{1}{7}$	24	$10\frac{6}{7}$	24	$15\frac{4}{7}$	25	$2\frac{3}{7}$	25	$7\frac{1}{7}$
3000	150	36	2	36	$9\frac{1}{7}$	36	$16\frac{2}{7}$	37	$5\frac{3}{7}$	37	$12\frac{4}{7}$	38	$1\frac{5}{7}$
4000	200	48	$2\frac{5}{7}$	48	$12\frac{1}{7}$	49	$3\frac{5}{7}$	49	$13\frac{2}{7}$	50	$4\frac{5}{7}$	50	$14\frac{2}{7}$

Ells.		$77\frac{3}{5}$		$78\frac{2}{5}$		$79\frac{1}{5}$		80		$80\frac{4}{5}$		$81\frac{3}{5}$	
Yards.		97		98		99		100		101		102	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$\frac{6}{7}$		1		1		1		1		1
5	$\frac{1}{4}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$
10	$\frac{1}{2}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$
20	1		$4\frac{4}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$		$4\frac{6}{7}$
30	$1\frac{1}{2}$		$6\frac{6}{7}$		7		7		$7\frac{1}{7}$		$7\frac{1}{7}$		$7\frac{2}{7}$
40	2		$9\frac{2}{7}$		$9\frac{2}{7}$		$9\frac{3}{7}$		$9\frac{4}{7}$		$9\frac{5}{7}$		$9\frac{5}{7}$
50	$2\frac{1}{2}$		$11\frac{4}{7}$		$11\frac{5}{7}$		$11\frac{5}{7}$		$11\frac{6}{7}$		12		$12\frac{1}{7}$
60	3		$13\frac{6}{7}$		14		$14\frac{1}{7}$		$14\frac{2}{7}$		$14\frac{3}{7}$		$14\frac{4}{7}$
70	$3\frac{1}{2}$		$16\frac{1}{7}$		$16\frac{2}{7}$		$16\frac{3}{7}$		$16\frac{5}{7}$		$16\frac{5}{7}$		17
80	4	1	$\frac{3}{7}$	1	$\frac{5}{7}$	1	$\frac{6}{7}$	1	1	1	$1\frac{1}{7}$	1	$1\frac{3}{7}$
90	$4\frac{1}{2}$	1	$2\frac{5}{7}$	1	3	1	$3\frac{1}{7}$	1	$3\frac{3}{7}$	1	$3\frac{4}{7}$	1	$3\frac{6}{7}$
100	5	1	$5\frac{1}{7}$	1	$5\frac{2}{7}$	1	$5\frac{4}{7}$	1	$5\frac{6}{7}$	1	6	1	$6\frac{2}{7}$
200	10	2	$10\frac{1}{7}$	2	$10\frac{5}{7}$	2	$11\frac{1}{7}$	2	$11\frac{4}{7}$	2	12	2	$12\frac{4}{7}$
300	15	3	$15\frac{2}{7}$	3	16	3	$16\frac{5}{7}$	3	$17\frac{3}{7}$	4	$\frac{1}{7}$	4	$\frac{6}{7}$
400	20	5	$2\frac{3}{7}$	5	$3\frac{2}{7}$	5	$4\frac{2}{7}$	5	$5\frac{2}{7}$	5	$6\frac{1}{7}$	5	$7\frac{1}{7}$
500	25	6	$7\frac{3}{7}$	6	$8\frac{5}{7}$	6	$9\frac{6}{7}$	6	11	6	$12\frac{1}{7}$	6	$13\frac{3}{7}$
600	30	7	$12\frac{4}{7}$	7	14	7	$15\frac{3}{7}$	7	$16\frac{6}{7}$	8	$\frac{2}{7}$	8	$1\frac{5}{7}$
700	35	8	$17\frac{5}{7}$	9	$1\frac{2}{7}$	9	3	9	$4\frac{5}{7}$	9	$6\frac{2}{7}$	9	8
800	40	10	$4\frac{5}{7}$	10	$6\frac{5}{7}$	10	$8\frac{4}{7}$	10	$10\frac{3}{7}$	10	$12\frac{2}{7}$	10	$14\frac{2}{7}$
900	45	11	$9\frac{6}{7}$	11	12	11	$14\frac{1}{7}$	11	$16\frac{2}{7}$	12	$\frac{3}{7}$	12	$2\frac{4}{7}$
1000	50	12	15	12	$17\frac{2}{7}$	13	$1\frac{5}{7}$	13	$4\frac{1}{7}$	13	$6\frac{3}{7}$	13	$8\frac{6}{7}$
2000	100	25	$11\frac{6}{7}$	25	$16\frac{5}{7}$	26	$3\frac{3}{7}$	26	$8\frac{1}{7}$	26	$12\frac{6}{7}$	26	$17\frac{5}{7}$
3000	150	38	$8\frac{2}{7}$	38	16	39	$5\frac{1}{7}$	39	$12\frac{2}{7}$	40	$1\frac{3}{7}$	40	$8\frac{4}{7}$
4000	200	51	$5\frac{6}{7}$	51	$15\frac{2}{7}$	52	$6\frac{6}{7}$	52	$16\frac{3}{7}$	53	$7\frac{6}{7}$	53	$17\frac{3}{7}$

Ells.		$82\frac{2}{5}$		$83\frac{1}{5}$		84		$84\frac{4}{5}$		$85\frac{3}{5}$		$86\frac{2}{5}$	
Yards.		103		104		105		106		107		108	
Splits.	Portei s.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		1		1		1		1		1		$1\frac{1}{7}$
5	$\frac{1}{4}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$
10	$\frac{1}{2}$		$2\frac{3}{7}$		$2\frac{4}{7}$		$2\frac{4}{7}$		$2\frac{4}{7}$		$2\frac{4}{7}$		$2\frac{4}{7}$
20	1		$4\frac{6}{7}$		$4\frac{6}{7}$		5		5		5		$5\frac{1}{7}$
30	$1\frac{1}{2}$		$7\frac{2}{7}$		$7\frac{3}{7}$		$7\frac{3}{7}$		$7\frac{4}{7}$		$7\frac{4}{7}$		$7\frac{5}{7}$
40	2		$9\frac{6}{7}$		10		10		$10\frac{1}{7}$		$10\frac{2}{7}$		$10\frac{2}{7}$
50	$2\frac{1}{2}$		$12\frac{1}{7}$		$12\frac{2}{7}$		$12\frac{3}{7}$		$12\frac{4}{7}$		$12\frac{5}{7}$		$12\frac{6}{7}$
60	3		$14\frac{5}{7}$		$14\frac{6}{7}$		15		$15\frac{1}{7}$		$15\frac{2}{7}$		$15\frac{3}{7}$
70	$3\frac{1}{2}$		$17\frac{1}{7}$		$17\frac{3}{7}$		$17\frac{4}{7}$		$17\frac{5}{7}$		$17\frac{6}{7}$	1	0
80	4	1	$1\frac{4}{7}$	1	$1\frac{5}{7}$	1	2	1	$2\frac{1}{7}$	1	$2\frac{2}{7}$	1	$2\frac{4}{7}$
90	$4\frac{1}{2}$	1	4	1	$4\frac{2}{7}$	1	$4\frac{3}{7}$	1	$4\frac{5}{7}$	1	$4\frac{6}{7}$	1	$5\frac{1}{7}$
100	5	1	$6\frac{4}{7}$	1	$6\frac{5}{7}$	1	7	1	$7\frac{2}{7}$	1	$7\frac{3}{7}$	1	$7\frac{5}{7}$
200	10	2	13	2	$13\frac{3}{7}$	2	14	2	$14\frac{3}{7}$	2	$14\frac{6}{7}$	2	$15\frac{3}{7}$
300	15	4	$1\frac{4}{7}$	4	$2\frac{2}{7}$	4	3	4	$3\frac{5}{7}$	4	$4\frac{3}{7}$	4	$5\frac{1}{7}$
400	20	5	$8\frac{1}{7}$	5	9	5	10	5	11	5	$11\frac{6}{7}$	5	$12\frac{6}{7}$
500	25	6	$14\frac{4}{7}$	6	$15\frac{5}{7}$	6	17	7	$\frac{1}{7}$	7	$1\frac{2}{7}$	7	$2\frac{4}{7}$
600	30	8	$3\frac{1}{7}$	8	$4\frac{4}{7}$	8	6	8	$7\frac{3}{7}$	8	$8\frac{6}{7}$	8	$10\frac{2}{7}$
700	35	9	$9\frac{5}{7}$	9	$11\frac{2}{7}$	9	13	9	$14\frac{5}{7}$	9	$16\frac{2}{7}$	10	0
800	40	10	$16\frac{1}{7}$	10	18	11	2	11	$3\frac{6}{7}$	11	$5\frac{5}{7}$	11	$7\frac{5}{7}$
900	45	12	$4\frac{5}{7}$	12	$6\frac{6}{7}$	12	9	12	$11\frac{1}{7}$	12	$13\frac{2}{7}$	12	$15\frac{3}{7}$
1000	50	13	$11\frac{2}{7}$	13	$13\frac{4}{7}$	13	16	14	$\frac{3}{7}$	14	$2\frac{5}{7}$	14	$5\frac{1}{7}$
2000	100	27	$4\frac{3}{7}$	27	$9\frac{1}{7}$	27	14	28	$\frac{5}{7}$	28	$5\frac{3}{7}$	28	$10\frac{2}{7}$
3000	150	40	$15\frac{5}{7}$	41	$4\frac{6}{7}$	41	12	42	$1\frac{1}{7}$	42	$8\frac{2}{7}$	42	$12\frac{3}{7}$
4000	200	54	9	55	$\frac{3}{7}$	55	10	56	$1\frac{4}{7}$	56	11	57	$2\frac{4}{7}$

Ells.		$87\frac{1}{5}$		88		$88\frac{4}{5}$		$89\frac{3}{5}$		$90\frac{2}{5}$		$91\frac{1}{5}$	
Yards.		109		110		111		112		113		114	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$
5	$\frac{1}{4}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$
10	$\frac{1}{2}$		$2\frac{4}{7}$		$2\frac{5}{7}$		$2\frac{5}{7}$		$2\frac{5}{7}$		$2\frac{5}{7}$		$2\frac{6}{7}$
20	1		$5\frac{1}{7}$		$5\frac{1}{7}$		$5\frac{1}{7}$		$5\frac{2}{7}$		$5\frac{2}{7}$		$5\frac{2}{7}$
30	$1\frac{1}{2}$		$7\frac{5}{7}$		$7\frac{6}{7}$		$7\frac{6}{7}$		8		8		$8\frac{1}{7}$
40	2		$10\frac{3}{7}$		$10\frac{4}{7}$		$10\frac{5}{7}$		$10\frac{5}{7}$		$10\frac{6}{7}$		11
50	$2\frac{1}{2}$		$12\frac{6}{7}$		13		$13\frac{1}{7}$		$13\frac{2}{7}$		$13\frac{2}{7}$		$13\frac{3}{7}$
60	3		$15\frac{4}{7}$		$15\frac{5}{7}$		$15\frac{6}{7}$		16		$16\frac{1}{7}$		$16\frac{2}{7}$
70	$3\frac{1}{2}$	1	$\frac{1}{7}$	1	$\frac{1}{7}$	1	$\frac{3}{7}$	1	$\frac{3}{7}$	1	$\frac{4}{7}$	1	$\frac{6}{7}$
80	4	1	$2\frac{5}{7}$	1	$2\frac{6}{7}$	1	3	1	$3\frac{2}{7}$	1	$3\frac{3}{7}$	1	$3\frac{4}{7}$
90	$4\frac{1}{2}$	1	$5\frac{2}{7}$	1	$5\frac{4}{7}$	1	$5\frac{5}{7}$	1	6	1	$6\frac{1}{7}$	1	$6\frac{3}{7}$
100	5	1	8	1	$8\frac{1}{7}$	1	$8\frac{3}{7}$	1	$8\frac{4}{7}$	1	$8\frac{6}{7}$	1	$9\frac{1}{7}$
200	10	2	$15\frac{6}{7}$	2	$16\frac{2}{7}$	2	$16\frac{5}{7}$	2	$17\frac{2}{7}$	2	$17\frac{5}{7}$	3	$\frac{1}{7}$
300	15	4	$5\frac{6}{7}$	4	$6\frac{4}{7}$	4	$7\frac{2}{7}$	4	8	4	$8\frac{5}{7}$	4	$9\frac{3}{7}$
400	20	5	$13\frac{6}{7}$	5	$14\frac{5}{7}$	5	$15\frac{5}{7}$	5	$16\frac{4}{7}$	5	$17\frac{4}{7}$	6	1
500	25	7	$3\frac{5}{7}$	7	$4\frac{6}{7}$	7	6	7	$7\frac{2}{7}$	7	$8\frac{3}{7}$	7	9
600	30	8	$11\frac{5}{7}$	8	$13\frac{1}{7}$	8	$14\frac{4}{7}$	8	16	8	$17\frac{3}{7}$	9	$\frac{6}{7}$
700	35	10	$1\frac{5}{7}$	10	$3\frac{2}{7}$	10	5	10	$6\frac{4}{7}$	10	$8\frac{2}{7}$	10	10
800	40	11	$9\frac{4}{7}$	11	$11\frac{3}{7}$	11	$13\frac{2}{7}$	11	$15\frac{2}{7}$	11	$17\frac{1}{7}$	12	$\frac{1}{7}$
900	45	12	$17\frac{4}{7}$	13	$1\frac{5}{7}$	13	$3\frac{6}{7}$	13	6	13	$8\frac{1}{7}$	13	$10\frac{2}{7}$
1000	50	14	$7\frac{4}{7}$	14	$9\frac{6}{7}$	14	$12\frac{2}{7}$	14	$14\frac{4}{7}$	14	17	15	$1\frac{3}{7}$
2000	100	28	15	29	$1\frac{5}{7}$	29	$6\frac{3}{7}$	29	$11\frac{2}{7}$	29	16	30	$2\frac{5}{7}$
3000	150	43	$4\frac{4}{7}$	43	$11\frac{5}{7}$	44	$\frac{6}{7}$	44	8	44	$15\frac{1}{7}$	45	$4\frac{2}{7}$
4000	200	57	$12\frac{1}{7}$	58	$3\frac{4}{7}$	58	$13\frac{1}{7}$	59	$4\frac{4}{7}$	59	$14\frac{1}{7}$	60	$5\frac{5}{7}$

Ells.		92		92 4/5		93 3/5		94 2/5		95 3/5		96	
Yards.		115		116		117		118		119		120	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	1/10												
4	1/5		1 1/7		1 1/7		1 1/7		1 1/7		1 1/7		1 1/7
5	1/4		1 2/7		1 2/7		1 3/7		1 3/7		1 3/7		1 3/7
10	1/2		2 6/7		2 6/7		2 6/7		2 6/7		2 6/7		2 6/7
20	1		5 3/7		5 3/7		5 3/7		5 4/7		5 4/7		5 5/7
30	1 1/2		8 1/7		8 2/7		8 2/7		8 3/7		8 3/7		8 4/7
40	2		11		11		11 1/7		11 1/7		11 2/7		11 3/7
50	2 1/2		13 4/7		13 5/7		13 6/7		14		14		14 2/7
60	3		16 3/7		16 4/7		16 5/7		16 6/7		17		17 1/7
70	3 1/2	1	1 1/7	1	1 2/7	1	1 3/7	1	1 4/7	1	1 5/7	1	2
80	4	1	3 6/7	1	4	1	4 1/7	1	4 3/7	1	4 4/7	1	4 6/7
90	4 1/2	1	6 4/7	1	6 6/7	1	7	1	7 2/7	1	7 3/7	1	7 5/7
100	5	1	9 2/7	1	9 4/7	1	9 5/7	1	10	1	10 2/7	1	10 4/7
200	10	3	5/7	3	1 1/7	3	1 4/7	3	2 1/7	3	2 4/7	3	3 1/7
300	15	4	10 1/7	4	10 6/7	4	11 4/7	4	12 2/7	4	13	4	13 5/7
400	20	6	1 3/7	6	2 3/7	6	3 3/7	6	4 2/7	6	5 2/7	6	6 2/7
500	25	7	10 6/7	7	12	7	13 1/7	7	14 3/7	7	15 4/7	7	16 6/7
600	30	9	2 2/7	9	3 5/7	9	5 1/7	9	6 4/7	9	8	9	9 3/7
700	35	10	11 4/7	10	13 2/7	10	15	10	16 4/7	11	2/7	11	2
800	40	12	3	12	4 6/7	12	6 5/7	12	8 5/7	12	10 4/7	12	12 4/7
900	45	13	12 3/7	13	14 4/7	13	16 5/7	14	6/7	14	3	14	4 1/7
1000	50	15	3 4/7	15	6 1/7	15	8 4/7	15	10 6/7	15	13 2/7	15	17 5/7
2000	100	30	7 1/7	30	12 2/7	30	17	31	3 6/7	31	8 5/7	31	13 3/7
3000	150	45	11 3/7	46	4/7	46	7 5/7	46	14 6/7	47	4	47	9 1/7
4000	200	60	15 1/7	61	6 5/7	61	16 2/7	62	7 5/7	62	17 3/7	63	8 6/7

Ells.		$96\frac{4}{5}$		$97\frac{3}{5}$		$98\frac{2}{5}$		$99\frac{1}{5}$		100		$100\frac{4}{5}$	
Yards.		121		122		123		124		125		126	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$		$1\frac{1}{7}$
5	$\frac{1}{4}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$
10	$\frac{1}{2}$		$2\frac{6}{7}$		$2\frac{6}{7}$		$2\frac{6}{7}$		3		3		3
20	1		$5\frac{5}{7}$		$5\frac{6}{7}$		$5\frac{6}{7}$		$5\frac{6}{7}$		6		6
30	$1\frac{1}{2}$		$8\frac{4}{7}$		$8\frac{5}{7}$		$8\frac{5}{7}$		$8\frac{6}{7}$		$8\frac{6}{7}$		9
40	2		$11\frac{4}{7}$		$11\frac{4}{7}$		$11\frac{5}{7}$		$11\frac{6}{7}$		$11\frac{6}{7}$		12
50	$2\frac{1}{2}$		$14\frac{3}{7}$		$14\frac{4}{7}$		$14\frac{4}{7}$		$14\frac{5}{7}$		$14\frac{6}{7}$		15
60	3		$17\frac{2}{7}$		$17\frac{3}{7}$		$17\frac{4}{7}$		$17\frac{5}{7}$		$17\frac{6}{7}$	1	0
70	$3\frac{1}{2}$	1	$2\frac{1}{7}$	1	$2\frac{2}{7}$	1	$2\frac{3}{7}$	1	$2\frac{5}{7}$	1	3	1	3
80	4	1	5	1	$5\frac{1}{7}$	1	$5\frac{3}{7}$	1	$5\frac{4}{7}$	1	$5\frac{5}{7}$	1	6
90	$4\frac{1}{2}$	1	$7\frac{6}{7}$	1	$8\frac{1}{7}$	1	$8\frac{2}{7}$	1	$8\frac{4}{7}$	1	$8\frac{5}{7}$	1	9
100	5	1	$10\frac{5}{7}$	1	11	1	$11\frac{2}{7}$	1	$11\frac{3}{7}$	1	$11\frac{5}{7}$	1	12
200	10	3	$3\frac{4}{7}$	3	4	3	$4\frac{4}{7}$	3	5	3	$5\frac{3}{7}$	3	6
300	15	4	$14\frac{3}{7}$	4	$15\frac{1}{7}$	4	$15\frac{6}{7}$	4	$16\frac{4}{7}$	4	$17\frac{2}{7}$	5	0
400	20	6	$7\frac{1}{7}$	6	$8\frac{1}{7}$	6	$9\frac{1}{7}$	6	10	6	11	6	12
500	25	8	0	8	$1\frac{1}{7}$	8	$2\frac{3}{7}$	8	$3\frac{4}{7}$	8	$4\frac{5}{7}$	8	6
600	30	9	$10\frac{6}{7}$	9	$12\frac{2}{7}$	9	$13\frac{5}{7}$	9	$15\frac{1}{7}$	9	$16\frac{4}{7}$	10	0
700	35	11	$3\frac{4}{7}$	11	$5\frac{2}{7}$	11	7	11	$8\frac{4}{7}$	11	$10\frac{2}{7}$	11	12
800	40	12	$14\frac{3}{7}$	12	$16\frac{2}{7}$	13	$\frac{2}{7}$	13	$2\frac{1}{7}$	13	4	13	6
900	45	14	$7\frac{2}{7}$	14	$9\frac{3}{7}$	14	$11\frac{4}{7}$	14	$13\frac{5}{7}$	14	$15\frac{6}{7}$	15	0
1000	50	16	0	16	$2\frac{3}{7}$	16	$4\frac{6}{7}$	16	$7\frac{1}{7}$	16	$9\frac{4}{7}$	16	12
2000	100	32	$1\frac{1}{7}$	32	$4\frac{6}{7}$	32	$9\frac{5}{7}$	32	$14\frac{3}{7}$	33	$1\frac{1}{7}$	33	6
3000	150	48	$\frac{2}{7}$	48	$7\frac{3}{7}$	48	$14\frac{4}{7}$	49	$3\frac{5}{7}$	49	$10\frac{6}{7}$	50	0
4000	200	64	$\frac{2}{7}$	64	$9\frac{6}{7}$	65	$1\frac{3}{7}$	65	$10\frac{6}{7}$	66	$2\frac{3}{7}$	66	12

Ells.		$101\frac{3}{5}$		$102\frac{2}{5}$		$103\frac{1}{5}$		104		$104\frac{4}{5}$		$105\frac{3}{5}$	
Yards.		127		128		129		130		131		132	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{1}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$
5	$\frac{1}{4}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$
10	$\frac{1}{2}$		3		3		3		$3\frac{1}{7}$		$3\frac{1}{7}$		$3\frac{1}{7}$
20	1		6		$6\frac{1}{7}$		$6\frac{1}{7}$		$6\frac{1}{7}$		$6\frac{1}{7}$		$6\frac{2}{7}$
30	$1\frac{1}{2}$		9		$9\frac{1}{7}$		$9\frac{1}{7}$		$9\frac{2}{7}$		$9\frac{2}{7}$		$9\frac{3}{7}$
40	2		12		$12\frac{1}{7}$		$12\frac{2}{7}$		$12\frac{2}{7}$		$12\frac{3}{7}$		$12\frac{4}{7}$
50	$2\frac{1}{2}$		$15\frac{1}{7}$		$15\frac{1}{7}$		$15\frac{2}{7}$		$15\frac{3}{7}$		$15\frac{4}{7}$		$15\frac{5}{7}$
60	3	1	$\frac{1}{7}$	1	$\frac{2}{7}$	1	$\frac{3}{7}$	1	$\frac{4}{7}$	1	$\frac{5}{7}$	1	$\frac{6}{7}$
70	$3\frac{1}{2}$	1	$3\frac{1}{7}$	1	$3\frac{2}{7}$	1	$3\frac{3}{7}$	1	$3\frac{5}{7}$	1	$3\frac{6}{7}$	1	4
80	4	1	$6\frac{1}{7}$	1	$6\frac{2}{7}$	1	$6\frac{4}{7}$	1	$6\frac{5}{7}$	1	$6\frac{6}{7}$	1	$7\frac{1}{7}$
90	$4\frac{1}{2}$	1	$9\frac{1}{7}$	1	$9\frac{3}{7}$	1	$9\frac{4}{7}$	1	$9\frac{6}{7}$	1	10	1	$10\frac{2}{7}$
100	5	1	$12\frac{1}{7}$	1	$12\frac{3}{7}$	1	$12\frac{5}{7}$	1	13	1	$13\frac{1}{7}$	1	$13\frac{3}{7}$
200	10	3	$6\frac{3}{7}$	3	$6\frac{6}{7}$	3	$7\frac{3}{7}$	3	$7\frac{6}{7}$	3	$8\frac{3}{7}$	3	$8\frac{6}{7}$
300	15	5	$\frac{5}{7}$	5	$1\frac{3}{7}$	5	$2\frac{1}{7}$	5	$2\frac{6}{7}$	5	$3\frac{4}{7}$	5	$4\frac{2}{7}$
400	20	6	13	6	$13\frac{6}{7}$	6	$14\frac{6}{7}$	6	$15\frac{6}{7}$	6	$16\frac{5}{7}$	6	$17\frac{5}{7}$
500	25	8	$7\frac{1}{7}$	8	$8\frac{2}{7}$	8	$9\frac{4}{7}$	8	$10\frac{5}{7}$	8	$11\frac{6}{7}$	8	$13\frac{1}{7}$
600	30	10	$1\frac{3}{7}$	10	$2\frac{6}{7}$	10	$4\frac{2}{7}$	10	$5\frac{5}{7}$	10	$7\frac{1}{7}$	10	$8\frac{4}{7}$
700	35	11	$13\frac{1}{7}$	11	$15\frac{2}{7}$	11	17	12	$\frac{5}{7}$	12	$2\frac{2}{7}$	12	4
800	40	13	$7\frac{6}{7}$	13	$9\frac{5}{7}$	13	$11\frac{5}{7}$	13	$13\frac{4}{7}$	13	$15\frac{3}{7}$	13	$17\frac{3}{7}$
900	45	15	$2\frac{1}{7}$	15	$4\frac{2}{7}$	15	$6\frac{3}{7}$	15	$8\frac{4}{7}$	15	$10\frac{5}{7}$	15	$12\frac{6}{7}$
1000	50	16	$14\frac{2}{7}$	16	$16\frac{5}{7}$	17	$1\frac{1}{7}$	17	$3\frac{4}{7}$	17	$5\frac{6}{7}$	17	$8\frac{2}{7}$
2000	100	33	$10\frac{5}{7}$	33	$15\frac{3}{7}$	34	$2\frac{2}{7}$	34	7	34	$11\frac{5}{7}$	34	$16\frac{4}{7}$
3000	150	50	$11\frac{1}{7}$	50	$14\frac{2}{7}$	51	$3\frac{3}{7}$	51	$10\frac{4}{7}$	51	$17\frac{5}{7}$	52	$6\frac{6}{7}$
4000	200	67	$3\frac{3}{7}$	67	13	68	$4\frac{1}{7}$	68	$14\frac{1}{7}$	69	$5\frac{4}{7}$	69	$15\frac{1}{7}$

Ells.		$106\frac{2}{5}$		$107\frac{1}{5}$		108		$108\frac{4}{5}$		$109\frac{3}{5}$		$110\frac{2}{5}$	
Yards.		133		134		135		136		137		138	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{2}{7}$		$1\frac{3}{7}$
5	$\frac{1}{4}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$
10	$\frac{1}{2}$		$3\frac{1}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$		$3\frac{2}{7}$
20	1		$6\frac{2}{7}$		$6\frac{2}{7}$		$6\frac{3}{7}$		$6\frac{3}{7}$		$6\frac{3}{7}$		$6\frac{4}{7}$
30	$1\frac{1}{2}$		$9\frac{3}{7}$		$9\frac{4}{7}$		$9\frac{4}{7}$		$9\frac{5}{7}$		$9\frac{5}{7}$		$9\frac{6}{7}$
40	2		$12\frac{5}{7}$		$12\frac{6}{7}$		$12\frac{6}{7}$		13		$13\frac{1}{7}$		$13\frac{1}{7}$
50	$2\frac{1}{2}$		$15\frac{5}{7}$		$15\frac{6}{7}$		16		$16\frac{1}{7}$		$16\frac{2}{7}$		$16\frac{3}{7}$
60	3	1	1	1	$1\frac{1}{7}$	1	$1\frac{2}{7}$	1	$1\frac{3}{7}$	1	$1\frac{4}{7}$	1	$1\frac{5}{7}$
70	$3\frac{1}{2}$	1	$4\frac{1}{7}$	1	$4\frac{2}{7}$	1	$4\frac{3}{7}$	1	$4\frac{5}{7}$	1	$4\frac{6}{7}$	1	5
80	4	1	$7\frac{2}{7}$	1	$7\frac{3}{7}$	1	$7\frac{5}{7}$	1	$7\frac{6}{7}$	1	8	1	$8\frac{2}{7}$
90	$4\frac{1}{2}$	1	$10\frac{3}{7}$	1	$10\frac{5}{7}$	1	$10\frac{6}{7}$	1	$11\frac{1}{7}$	1	$11\frac{2}{7}$	1	$11\frac{4}{7}$
100	5	1	$13\frac{5}{7}$	1	$13\frac{5}{7}$	1	$14\frac{1}{7}$	1	$14\frac{3}{7}$	1	$14\frac{4}{7}$	1	$14\frac{6}{7}$
200	10	3	$9\frac{2}{7}$	3	$9\frac{5}{7}$	3	$10\frac{2}{7}$	3	$10\frac{5}{7}$	3	$11\frac{1}{7}$	3	$11\frac{5}{7}$
300	15	5	5	5	$5\frac{5}{7}$	5	$6\frac{3}{7}$	5	$7\frac{1}{7}$	5	$7\frac{6}{7}$	5	$8\frac{4}{7}$
400	20	7	$\frac{5}{7}$	7	$1\frac{4}{7}$	7	$2\frac{4}{7}$	7	$3\frac{4}{7}$	7	$4\frac{3}{7}$	7	$5\frac{3}{7}$
500	25	8	$14\frac{2}{7}$	8	$15\frac{3}{7}$	8	$16\frac{5}{7}$	8	$17\frac{6}{7}$	9	1	9	$2\frac{2}{7}$
600	30	10	10	10	$11\frac{3}{7}$	10	$12\frac{6}{7}$	10	$14\frac{2}{7}$	10	$15\frac{5}{7}$	10	$17\frac{1}{7}$
700	35	12	$5\frac{5}{7}$	12	$7\frac{2}{7}$	12	9	12	$10\frac{5}{7}$	12	$12\frac{2}{7}$	12	14
800	40	14	$1\frac{2}{7}$	14	$3\frac{1}{7}$	14	$5\frac{1}{7}$	14	7	14	$8\frac{6}{7}$	14	$10\frac{6}{7}$
900	45	15	14	15	$17\frac{1}{7}$	16	$1\frac{2}{7}$	16	$3\frac{3}{7}$	16	$5\frac{4}{7}$	16	$7\frac{5}{7}$
1000	50	17	$10\frac{5}{7}$	17	13	17	$15\frac{3}{7}$	17	$17\frac{6}{7}$	18	$2\frac{1}{7}$	18	$4\frac{3}{7}$
2000	100	35	$3\frac{2}{7}$	35	8	35	$12\frac{6}{7}$	35	$17\frac{4}{7}$	36	$4\frac{2}{7}$	36	$9\frac{1}{7}$
3000	150	52	14	53	$3\frac{1}{7}$	53	$10\frac{2}{7}$	53	$17\frac{3}{7}$	54	$6\frac{4}{7}$	54	$13\frac{5}{7}$
4000	200	70	$6\frac{5}{7}$	70	$16\frac{1}{7}$	71	$7\frac{5}{7}$	71	$17\frac{2}{7}$	72	$8\frac{5}{7}$	73	$\frac{2}{7}$

Ells.		$111\frac{1}{5}$		112		$112\frac{4}{5}$		$113\frac{3}{5}$		$114\frac{2}{5}$		$115\frac{1}{5}$	
Yards.		139		140		141		142		143		144	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$
5	$\frac{1}{4}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$
10	$\frac{1}{2}$		$3\frac{2}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$
20	1		$6\frac{4}{7}$		$6\frac{4}{7}$		$6\frac{4}{7}$		$6\frac{5}{7}$		$6\frac{5}{7}$		$6\frac{5}{7}$
30	$1\frac{1}{2}$		$9\frac{6}{7}$		10		10		$10\frac{1}{7}$		$10\frac{2}{7}$		$10\frac{2}{7}$
40	2		$13\frac{2}{7}$		$13\frac{3}{7}$		$13\frac{4}{7}$		$13\frac{5}{7}$		$13\frac{5}{7}$		$13\frac{6}{7}$
50	$2\frac{1}{2}$		$16\frac{3}{7}$		$16\frac{4}{7}$		$16\frac{5}{7}$		$16\frac{6}{7}$		$16\frac{6}{7}$		17
60	3	1	2	1	2	1	$2\frac{1}{7}$	1	$2\frac{2}{7}$	1	$2\frac{3}{7}$	1	$2\frac{4}{7}$
70	$3\frac{1}{2}$	1	$5\frac{1}{7}$	1	$5\frac{2}{7}$	1	$5\frac{3}{7}$	1	$5\frac{4}{7}$	1	$5\frac{5}{7}$	1	6
80	4	1	$8\frac{3}{7}$	1	$8\frac{4}{7}$	1	$8\frac{5}{7}$	1	9	1	$9\frac{1}{7}$	1	$9\frac{2}{7}$
90	$4\frac{1}{2}$	1	$11\frac{5}{7}$	1	12	1	$12\frac{1}{7}$	1	$12\frac{3}{7}$	1	$12\frac{4}{7}$	1	$12\frac{6}{7}$
100	5	1	$15\frac{1}{7}$	1	$15\frac{2}{7}$	1	$15\frac{4}{7}$	1	$15\frac{5}{7}$	1	16	1	$16\frac{2}{7}$
200	10	3	$12\frac{1}{7}$	3	$12\frac{4}{7}$	3	13	3	$13\frac{4}{7}$	3	14	3	$14\frac{3}{7}$
300	15	5	$9\frac{2}{7}$	5	10	5	$10\frac{5}{7}$	5	$11\frac{3}{7}$	5	$12\frac{1}{7}$	5	$12\frac{6}{7}$
400	20	7	$6\frac{3}{7}$	7	$7\frac{2}{7}$	7	$8\frac{2}{7}$	7	$9\frac{1}{7}$	7	$10\frac{2}{7}$	7	$11\frac{1}{7}$
500	25	9	$3\frac{3}{7}$	9	$4\frac{4}{7}$	9	$5\frac{5}{7}$	9	7	9	$8\frac{1}{7}$	9	$9\frac{2}{7}$
600	30	11	$\frac{4}{7}$	11	2	11	$3\frac{3}{7}$	11	$4\frac{6}{7}$	11	$6\frac{2}{7}$	11	$7\frac{5}{7}$
700	35	12	$15\frac{5}{7}$	12	$17\frac{2}{7}$	13	1	13	$2\frac{4}{7}$	13	$4\frac{2}{7}$	13	6
800	40	14	$12\frac{5}{7}$	14	$14\frac{4}{7}$	14	$16\frac{3}{7}$	15	$\frac{3}{7}$	15	$2\frac{2}{7}$	15	$4\frac{1}{7}$
900	45	16	$9\frac{6}{7}$	16	12	16	$14\frac{1}{7}$	16	$16\frac{2}{7}$	17	$\frac{3}{7}$	17	$2\frac{4}{7}$
1000	50	18	7	18	$9\frac{2}{7}$	18	$11\frac{5}{7}$	18	14	18	$16\frac{3}{7}$	19	$\frac{6}{7}$
2000	100	36	$13\frac{6}{7}$	37	$\frac{4}{7}$	37	$5\frac{2}{7}$	37	10	37	$14\frac{6}{7}$	38	$1\frac{4}{7}$
3000	150	55	$2\frac{6}{7}$	55	10	55	$17\frac{1}{7}$	56	$6\frac{2}{7}$	56	$13\frac{3}{7}$	57	$2\frac{4}{7}$
4000	200	73	$9\frac{6}{7}$	74	$1\frac{2}{7}$	74	$10\frac{5}{7}$	75	$2\frac{2}{7}$	75	$11\frac{6}{7}$	76	$3\frac{3}{7}$

Ells.		116		$116\frac{4}{5}$		$117\frac{3}{5}$		$118\frac{2}{5}$		$119\frac{1}{5}$		120	
Yards.		145		146		147		148		149		150	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$
5	$\frac{1}{4}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$
10	$\frac{1}{2}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{5}{7}$
20	1		$6\frac{5}{7}$		$6\frac{6}{7}$		$6\frac{6}{7}$		7		7		$7\frac{1}{7}$
30	$1\frac{1}{2}$		$10\frac{2}{7}$		$10\frac{3}{7}$		$10\frac{3}{7}$		$10\frac{4}{7}$		$10\frac{4}{7}$		$10\frac{5}{7}$
40	2		$13\frac{6}{7}$		14		$14\frac{1}{7}$		$14\frac{1}{7}$		$14\frac{2}{7}$		$14\frac{2}{7}$
50	$2\frac{1}{2}$		$17\frac{1}{7}$		$17\frac{2}{7}$		$17\frac{3}{7}$		$17\frac{4}{7}$		$17\frac{5}{7}$		$17\frac{6}{7}$
60	3	1	$2\frac{5}{7}$	1	$2\frac{6}{7}$	1	3	1	$3\frac{1}{7}$	1	$3\frac{2}{7}$	1	$3\frac{3}{7}$
70	$3\frac{1}{2}$	1	$6\frac{1}{7}$	1	$6\frac{2}{7}$	1	$6\frac{3}{7}$	1	$6\frac{4}{7}$	1	$6\frac{5}{7}$	1	7
80	4	1	$9\frac{4}{7}$	1	$9\frac{5}{7}$	1	$9\frac{6}{7}$	1	$10\frac{1}{7}$	1	$10\frac{2}{7}$	1	$10\frac{4}{7}$
90	$4\frac{1}{2}$	1	13	1	$13\frac{2}{7}$	1	$13\frac{3}{7}$	1	$13\frac{5}{7}$	1	$13\frac{6}{7}$	1	$14\frac{1}{7}$
100	5	1	$16\frac{3}{7}$	1	$16\frac{5}{7}$	1	17	1	$17\frac{2}{7}$	1	$17\frac{3}{7}$	1	$17\frac{5}{7}$
200	10	3	15	3	$15\frac{3}{7}$	3	$15\frac{6}{7}$	3	$16\frac{3}{7}$	3	$16\frac{6}{7}$	3	$17\frac{3}{7}$
300	15	5	$13\frac{4}{7}$	5	$14\frac{2}{7}$	5	15	5	$15\frac{5}{7}$	5	$16\frac{3}{7}$	5	$17\frac{1}{7}$
400	20	7	12	7	13	7	14	7	$14\frac{6}{7}$	7	$15\frac{6}{7}$	7	$16\frac{6}{7}$
500	25	9	$10\frac{4}{7}$	9	$11\frac{5}{7}$	9	$12\frac{6}{7}$	9	$14\frac{1}{7}$	9	$15\frac{2}{7}$	9	$16\frac{4}{7}$
600	30	11	$9\frac{1}{7}$	11	$10\frac{4}{7}$	11	12	11	$13\frac{3}{7}$	11	$14\frac{6}{7}$	11	$16\frac{2}{7}$
700	35	13	$7\frac{2}{7}$	13	$9\frac{2}{7}$	13	11	13	$12\frac{4}{7}$	13	$14\frac{2}{7}$	13	16
800	40	15	$6\frac{1}{7}$	15	8	15	$9\frac{6}{7}$	15	$11\frac{6}{7}$	15	$13\frac{5}{7}$	15	$15\frac{5}{7}$
900	45	17	$4\frac{5}{7}$	17	$6\frac{6}{7}$	17	9	17	$11\frac{1}{7}$	17	$13\frac{2}{7}$	17	$15\frac{3}{7}$
1000	50	19	$3\frac{1}{7}$	19	$5\frac{4}{7}$	19	8	19	$10\frac{2}{7}$	19	$12\frac{5}{7}$	19	$15\frac{1}{7}$
2000	100	38	$6\frac{3}{7}$	38	$11\frac{1}{7}$	38	$15\frac{6}{7}$	39	$2\frac{5}{7}$	39	$7\frac{3}{7}$	39	$12\frac{2}{7}$
3000	150	57	$9\frac{5}{7}$	57	$16\frac{6}{7}$	58	6	58	$13\frac{1}{7}$	59	$2\frac{2}{7}$	59	$9\frac{3}{7}$
4000	200	76	$12\frac{6}{7}$	77	$4\frac{3}{7}$	77	14	78	$5\frac{3}{7}$	78	15	79	$6\frac{4}{7}$

Ells.		$120\frac{4}{5}$		$121\frac{3}{5}$		$122\frac{2}{5}$		$123\frac{1}{5}$		124		$124\frac{4}{5}$	
Yards.		151		152		153		154		155		156	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$		$1\frac{3}{7}$
5	$\frac{1}{4}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$
10	$\frac{1}{2}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{4}{7}$		$3\frac{5}{7}$		$3\frac{5}{7}$		$3\frac{5}{7}$
20	1		$7\frac{1}{7}$		$7\frac{2}{7}$		$7\frac{2}{7}$		$7\frac{2}{7}$		$7\frac{3}{7}$		$7\frac{3}{7}$
30	$1\frac{1}{2}$		$10\frac{6}{7}$		11		11		11		11		$11\frac{1}{7}$
40	2		$14\frac{2}{7}$		$14\frac{3}{7}$		$14\frac{4}{7}$		$14\frac{5}{7}$		$14\frac{5}{7}$		$14\frac{6}{7}$
50	$2\frac{1}{2}$	1	0	1	$\frac{1}{7}$	1	$\frac{1}{7}$	1	$\frac{2}{7}$	1	$\frac{3}{7}$	1	$\frac{4}{7}$
60	3	1	$3\frac{4}{7}$	1	$3\frac{5}{7}$	1	$3\frac{6}{7}$	1	4	1	$4\frac{1}{7}$	1	$4\frac{2}{7}$
70	$3\frac{1}{2}$	1	$7\frac{1}{7}$	1	$7\frac{2}{7}$	1	$7\frac{3}{7}$	1	$7\frac{5}{7}$	1	$7\frac{6}{7}$	1	8
80	4	1	$10\frac{5}{7}$	1	11	1	$11\frac{1}{7}$	1	$11\frac{2}{7}$	1	$11\frac{4}{7}$	1	$11\frac{5}{7}$
90	$4\frac{1}{2}$	1	$14\frac{2}{7}$	1	$14\frac{4}{7}$	1	$14\frac{5}{7}$	1	15	1	$15\frac{1}{7}$	1	$15\frac{3}{7}$
100	5	1	$17\frac{6}{7}$	2	$\frac{1}{7}$	2	$\frac{3}{7}$	2	$\frac{4}{7}$	2	$\frac{6}{7}$	2	$1\frac{1}{7}$
200	10	3	$17\frac{6}{7}$	4	$\frac{2}{7}$	4	$\frac{6}{7}$	4	$1\frac{2}{7}$	4	$1\frac{5}{7}$	4	$2\frac{2}{7}$
300	15	5	$17\frac{6}{7}$	6	$\frac{4}{7}$	6	$1\frac{2}{7}$	6	2	6	$2\frac{5}{7}$	6	$3\frac{3}{7}$
400	20	7	$17\frac{5}{7}$	8	$\frac{5}{7}$	8	$1\frac{5}{7}$	8	$2\frac{4}{7}$	8	$3\frac{4}{7}$	8	$4\frac{4}{7}$
500	25	9	$17\frac{5}{7}$	10	$\frac{6}{7}$	10	$2\frac{1}{7}$	10	$3\frac{2}{7}$	10	$4\frac{3}{7}$	10	$5\frac{5}{7}$
600	30	11	$17\frac{5}{7}$	12	$1\frac{2}{7}$	12	$2\frac{4}{7}$	12	4	12	$5\frac{3}{7}$	12	$6\frac{6}{7}$
700	35	13	$17\frac{4}{7}$	14	$1\frac{2}{7}$	14	3	14	$4\frac{4}{7}$	14	$6\frac{2}{7}$	14	$7\frac{6}{7}$
800	40	15	$17\frac{4}{7}$	16	$1\frac{3}{7}$	16	$3\frac{3}{7}$	16	$5\frac{2}{7}$	16	$7\frac{1}{7}$	16	$9\frac{1}{7}$
900	45	17	$17\frac{4}{7}$	18	$1\frac{5}{7}$	18	$3\frac{6}{7}$	18	6	18	$8\frac{1}{7}$	18	11
1000	50	19	$17\frac{4}{7}$	20	$1\frac{6}{7}$	20	$4\frac{2}{7}$	20	$6\frac{4}{7}$	20	9	20	$11\frac{3}{7}$
2000	100	39	17	40	$3\frac{5}{7}$	40	$8\frac{4}{7}$	40	$13\frac{2}{7}$	41	0	41	$4\frac{6}{7}$
3000	150	59	$16\frac{4}{7}$	60	$5\frac{5}{7}$	60	$12\frac{6}{7}$	61	2	61	$9\frac{1}{7}$	61	$16\frac{2}{7}$
4000	200	79	16	80	$7\frac{4}{7}$	80	$17\frac{1}{7}$	81	$8\frac{4}{7}$	82	$\frac{1}{7}$	82	$9\frac{5}{7}$

Ells.		$125\frac{3}{5}$		$126\frac{2}{5}$		$127\frac{1}{5}$		128		$128\frac{4}{5}$		$129\frac{3}{5}$	
Yards.		157		158		159		160		161		162	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{3}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$
5	$\frac{1}{4}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$
10	$\frac{1}{2}$		$3\frac{5}{7}$		$3\frac{5}{7}$		$3\frac{5}{7}$		$3\frac{6}{7}$		$3\frac{6}{7}$		$3\frac{6}{7}$
20	1		$7\frac{3}{7}$		$7\frac{4}{7}$		$7\frac{4}{7}$		$7\frac{4}{7}$		$7\frac{4}{7}$		$7\frac{5}{7}$
30	$1\frac{1}{2}$		$11\frac{1}{7}$		$11\frac{2}{7}$		$11\frac{2}{7}$		$11\frac{3}{7}$		$11\frac{3}{7}$		$11\frac{4}{7}$
40	2		$14\frac{6}{7}$		15		$15\frac{1}{7}$		$15\frac{2}{7}$		$15\frac{3}{7}$		$15\frac{3}{7}$
50	$2\frac{1}{2}$	1	$\frac{5}{7}$	1	$\frac{6}{7}$	1	$\frac{6}{7}$	1	1	1	$1\frac{1}{7}$	1	$1\frac{2}{7}$
60	3	1	$4\frac{3}{7}$	1	$4\frac{4}{7}$	1	$4\frac{5}{7}$	1	$4\frac{6}{7}$	1	5	1	$5\frac{1}{7}$
70	$3\frac{1}{2}$	1	$8\frac{1}{7}$	1	$8\frac{2}{7}$	1	$8\frac{3}{7}$	1	$8\frac{5}{7}$	1	$8\frac{6}{7}$	1	9
80	4	1	$11\frac{6}{7}$	1	12	1	$12\frac{1}{7}$	1	$12\frac{3}{7}$	1	$12\frac{4}{7}$	1	$12\frac{5}{7}$
90	$4\frac{1}{2}$	1	$15\frac{4}{7}$	1	$15\frac{6}{7}$	1	16	1	$16\frac{2}{7}$	1	$16\frac{4}{7}$	1	$16\frac{5}{7}$
100	5	2	$1\frac{2}{7}$	2	$1\frac{4}{7}$	2	$1\frac{5}{7}$	2	$2\frac{1}{7}$	2	$2\frac{3}{7}$	2	$2\frac{4}{7}$
200	10	4	$2\frac{5}{7}$	4	$3\frac{1}{7}$	4	$3\frac{5}{7}$	4	$4\frac{1}{7}$	4	$4\frac{4}{7}$	4	$5\frac{1}{7}$
300	15	6	$4\frac{1}{7}$	6	$4\frac{6}{7}$	6	$5\frac{4}{7}$	6	$6\frac{2}{7}$	6	7	6	$7\frac{5}{7}$
400	20	8	$5\frac{3}{7}$	8	$6\frac{3}{7}$	8	$7\frac{3}{7}$	8	$8\frac{3}{7}$	8	$9\frac{2}{7}$	8	$10\frac{2}{7}$
500	25	10	$6\frac{6}{7}$	10	8	10	$9\frac{2}{7}$	10	$10\frac{3}{7}$	10	$11\frac{4}{7}$	10	$12\frac{5}{7}$
600	30	12	$8\frac{2}{7}$	12	$9\frac{5}{7}$	12	$11\frac{1}{7}$	12	$12\frac{4}{7}$	12	14	12	$15\frac{3}{7}$
700	35	14	$9\frac{4}{7}$	14	$11\frac{2}{7}$	14	13	14	$14\frac{5}{7}$	14	$16\frac{2}{7}$	15	0
800	40	16	11	16	$12\frac{6}{7}$	16	$14\frac{6}{7}$	16	$16\frac{5}{7}$	17	$\frac{4}{7}$	17	$2\frac{4}{7}$
900	45	18	$12\frac{3}{7}$	18	$14\frac{4}{7}$	18	$16\frac{5}{7}$	19	$\frac{6}{7}$	19	3	19	$5\frac{1}{7}$
1000	50	20	$13\frac{5}{7}$	20	$16\frac{1}{7}$	21	$\frac{4}{7}$	21	3	21	$5\frac{2}{7}$	21	$7\frac{5}{7}$
2000	100	41	$9\frac{4}{7}$	41	$14\frac{2}{7}$	42	$1\frac{1}{7}$	42	$5\frac{6}{7}$	42	$10\frac{4}{7}$	42	$15\frac{3}{7}$
3000	150	62	$5\frac{3}{7}$	62	$12\frac{4}{7}$	63	$1\frac{5}{7}$	63	$8\frac{6}{7}$	63	16	64	$5\frac{1}{7}$
4000	200	83	$1\frac{1}{7}$	83	$10\frac{5}{7}$	84	$2\frac{2}{7}$	84	$11\frac{6}{7}$	85	$3\frac{2}{7}$	85	$12\frac{6}{7}$

Ells.		$130\frac{2}{5}$		$131\frac{1}{5}$		132		$132\frac{4}{5}$		$133\frac{3}{5}$		$134\frac{2}{5}$	
Yards.		163		164		165		166		167		168	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{4}{7}$		$1\frac{5}{7}$
5	$\frac{1}{4}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		2		2
10	$\frac{1}{2}$		$3\frac{6}{7}$		4		4		4		4		4
20	1		$7\frac{5}{7}$		$7\frac{5}{7}$		$7\frac{6}{7}$		$7\frac{6}{7}$		$7\frac{6}{7}$		8
30	$1\frac{1}{2}$		$11\frac{4}{7}$		$11\frac{5}{7}$		$11\frac{5}{7}$		$11\frac{6}{7}$		$11\frac{6}{7}$		12
40	2		$15\frac{4}{7}$		$15\frac{5}{7}$		$15\frac{5}{7}$		$15\frac{6}{7}$		16		16
50	$2\frac{1}{2}$	1	$1\frac{2}{7}$	1	$1\frac{3}{7}$	1	$1\frac{4}{7}$	1	$1\frac{5}{7}$	1	$1\frac{6}{7}$	1.	2
60	3	1	$5\frac{2}{7}$	1	$5\frac{3}{7}$	1	$5\frac{4}{7}$	1	$5\frac{5}{7}$	1	$5\frac{6}{7}$	1	6
70	$3\frac{1}{2}$	1	$9\frac{1}{7}$	1	$9\frac{3}{7}$	1	$9\frac{4}{7}$	1	$9\frac{5}{7}$	1	$9\frac{6}{7}$	1	10
80	4	1	13	1	$13\frac{1}{7}$	1	$13\frac{3}{7}$	1	$13\frac{4}{7}$	1	$13\frac{5}{7}$	1	14
90	$4\frac{1}{2}$	1	$16\frac{6}{7}$	1	$17\frac{1}{7}$	1	$17\frac{2}{7}$	1	$17\frac{4}{7}$	1	$17\frac{5}{7}$	2	0
100	5	2	$2\frac{6}{7}$	2	3	2	$3\frac{2}{7}$	2	$3\frac{4}{7}$	2	$3\frac{5}{7}$	2	4
200	10	4	$5\frac{4}{7}$	4	6	4	$6\frac{4}{7}$	4	7	4	$7\frac{3}{7}$	4	8
300	15	6	$8\frac{3}{7}$	6	$9\frac{1}{7}$	6	$9\frac{6}{7}$	6	$10\frac{4}{7}$	6	$11\frac{2}{7}$	6	12
400	20	8	$11\frac{2}{7}$	8	$12\frac{1}{7}$	8	$13\frac{1}{7}$	8	$14\frac{1}{7}$	8	15	8	16
500	25	10	14	10	$15\frac{1}{7}$	10	$16\frac{3}{7}$	10	$17\frac{4}{7}$	11	$\frac{5}{7}$	11	2
600	30	12	$16\frac{6}{7}$	13	$\frac{2}{7}$	13	$1\frac{5}{7}$	13	$3\frac{1}{7}$	13	$4\frac{4}{7}$	13	6
700	35	15	$1\frac{5}{7}$	15	$3\frac{2}{7}$	15	5	15	$6\frac{5}{7}$	15	$8\frac{2}{7}$	15	10
800	40	17	$4\frac{3}{7}$	17	$6\frac{2}{7}$	17	$8\frac{2}{7}$	17	$10\frac{1}{7}$	17	12	17	14
900	45	19	$7\frac{2}{7}$	19	$9\frac{3}{7}$	19	$11\frac{4}{7}$	19	$13\frac{5}{7}$	19	$15\frac{6}{7}$	20	0
1000	50	21	$10\frac{1}{7}$	21	$11\frac{3}{7}$	21	$14\frac{6}{7}$	21	17	22	$1\frac{4}{7}$	22	4
2000	100	43	$2\frac{1}{7}$	43	$6\frac{6}{7}$	43	$11\frac{5}{7}$	43	$16\frac{3}{7}$	44	$1\frac{1}{7}$	44	8
3000	150	64	$12\frac{2}{7}$	65	$1\frac{3}{7}$	65	$8\frac{4}{7}$	65	$15\frac{5}{7}$	66	$4\frac{6}{7}$	66	12
4000	200	86	$4\frac{3}{7}$	86	14	87	$5\frac{3}{7}$	87	15	88	$6\frac{3}{7}$	88	16

Ells.		$135\frac{1}{5}$		136		$136\frac{4}{5}$		$137\frac{3}{5}$		$138\frac{2}{5}$		$139\frac{1}{5}$	
Yards.		169		170		171		172		173		174	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$
5	$\frac{1}{4}$		2		2		2		2		2		2
10	$\frac{1}{2}$		4		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{1}{7}$
20	1		8		8		8		$8\frac{1}{7}$		$8\frac{1}{7}$		$8\frac{1}{7}$
30	$1\frac{1}{2}$		12		$12\frac{1}{7}$		$12\frac{1}{7}$		$12\frac{2}{7}$		$12\frac{2}{7}$		$12\frac{3}{7}$
40	2		$16\frac{1}{7}$		$16\frac{2}{7}$		$16\frac{3}{7}$		$16\frac{3}{7}$		$16\frac{4}{7}$		$16\frac{4}{7}$
50	$2\frac{1}{2}$	1	2	1	$2\frac{1}{7}$	1	$2\frac{2}{7}$	1	$2\frac{3}{7}$	1	$2\frac{3}{7}$	1	$2\frac{4}{7}$
60	3	1	$6\frac{1}{7}$	1	$6\frac{2}{7}$	1	$6\frac{3}{7}$	1	$6\frac{4}{7}$	1	$6\frac{5}{7}$	1	$6\frac{6}{7}$
70	$3\frac{1}{2}$	1	$10\frac{1}{7}$	1	$10\frac{3}{7}$	1	$10\frac{4}{7}$	1	$10\frac{5}{7}$	1	$10\frac{6}{7}$	1	11
80	4	1	$14\frac{1}{7}$	1	$14\frac{2}{7}$	1	$14\frac{3}{7}$	1	$14\frac{5}{7}$	1	$14\frac{6}{7}$	1	15
90	$4\frac{1}{2}$	2	$\frac{1}{7}$	2	$\frac{3}{7}$	2	$\frac{4}{7}$	2	$\frac{6}{7}$	2	1	2	$1\frac{2}{7}$
100	5	2	$4\frac{2}{7}$	2	$4\frac{3}{7}$	2	$4\frac{4}{7}$	2	$4\frac{6}{7}$	2	$5\frac{1}{7}$	2	$5\frac{2}{7}$
200	10	4	$8\frac{3}{7}$	4	$8\frac{6}{7}$	4	$9\frac{2}{7}$	4	$9\frac{6}{7}$	4	$10\frac{2}{7}$	4	$10\frac{5}{7}$
300	15	6	$12\frac{5}{7}$	6	$13\frac{3}{7}$	6	$14\frac{1}{7}$	6	$14\frac{6}{7}$	6	$15\frac{4}{7}$	6	$16\frac{2}{7}$
400	20	8	17	8	$17\frac{6}{7}$	9	$\frac{6}{7}$	9	$1\frac{5}{7}$	9	$2\frac{5}{7}$	9	$3\frac{4}{7}$
500	25	11	$3\frac{1}{7}$	11	$4\frac{2}{7}$	11	$5\frac{3}{7}$	11	$6\frac{5}{7}$	11	$7\frac{6}{7}$	11	9
600	30	13	$7\frac{3}{7}$	13	$8\frac{6}{7}$	13	$10\frac{2}{7}$	13	$11\frac{5}{7}$	13	$13\frac{1}{7}$	13	$14\frac{4}{7}$
700	35	15	$11\frac{5}{7}$	15	$13\frac{2}{7}$	15	15	15	$16\frac{4}{7}$	16	$\frac{2}{7}$	16	2
800	40	17	$15\frac{6}{7}$	17	$17\frac{5}{7}$	18	$1\frac{4}{7}$	18	$3\frac{4}{7}$	18	$5\frac{3}{7}$	18	$6\frac{2}{7}$
900	45	20	$2\frac{1}{7}$	20	$4\frac{2}{7}$	20	$6\frac{3}{7}$	20	$8\frac{4}{7}$	20	$10\frac{5}{7}$	20	$12\frac{6}{7}$
1000	50	22	$6\frac{3}{7}$	22	$8\frac{5}{7}$	22	$11\frac{6}{7}$	22	$13\frac{3}{7}$	22	$15\frac{6}{7}$	23	$\frac{2}{7}$
2000	100	44	$12\frac{5}{7}$	44	$17\frac{3}{7}$	45	$4\frac{1}{7}$	45	9	45	$13\frac{5}{7}$	46	$\frac{3}{7}$
3000	150	67	$1\frac{1}{7}$	67	$8\frac{2}{7}$	67	$15\frac{3}{7}$	68	$4\frac{4}{7}$	68	$11\frac{5}{7}$	69	$\frac{6}{7}$
4000	200	89	$7\frac{4}{7}$	89	17	90	$8\frac{4}{7}$	91	0	91	$9\frac{4}{7}$	92	$1\frac{1}{7}$

Ells.		140		$140\frac{4}{5}$		$141\frac{3}{5}$		$142\frac{2}{5}$		$143\frac{1}{5}$		144	
Yards.		175		176		177		178		179		180	
Splits.	Porters.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$
5	$\frac{1}{4}$		2		2		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$
10	$\frac{1}{2}$		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{1}{7}$		$4\frac{2}{7}$
20	1		$8\frac{2}{7}$		$8\frac{2}{7}$		$8\frac{2}{7}$		$8\frac{2}{7}$		$8\frac{3}{7}$		$8\frac{4}{7}$
30	$1\frac{1}{2}$		$12\frac{3}{7}$		$12\frac{4}{7}$		$12\frac{4}{7}$		$12\frac{5}{7}$		$12\frac{5}{7}$		$12\frac{6}{7}$
40	2		$16\frac{4}{7}$		$16\frac{5}{7}$		$16\frac{5}{7}$		$16\frac{6}{7}$		17		$17\frac{1}{7}$
50	$2\frac{1}{2}$	1	$2\frac{5}{7}$	1	$2\frac{6}{7}$	1	3	1	$3\frac{1}{7}$	1	$3\frac{2}{7}$	1	$3\frac{3}{7}$
60	3	1	7	1	$7\frac{1}{7}$	1	$7\frac{2}{7}$	1	$7\frac{3}{7}$	1	$7\frac{4}{7}$	1	$7\frac{6}{7}$
70	$3\frac{1}{2}$	1	$11\frac{1}{7}$	1	$11\frac{2}{7}$	1	$11\frac{3}{7}$	1	$11\frac{4}{7}$	1	$11\frac{5}{7}$	1	12
80	4	1	$15\frac{2}{7}$	1	$15\frac{3}{7}$	1	$15\frac{4}{7}$	1	$15\frac{6}{7}$	1	16	1	$16\frac{2}{7}$
90	$4\frac{1}{2}$	2	$1\frac{3}{7}$	2	$1\frac{5}{7}$	2	$1\frac{6}{7}$	2	$2\frac{1}{7}$	2	$2\frac{2}{7}$	2	$2\frac{4}{7}$
100	5	2	$5\frac{4}{7}$	2	$5\frac{6}{7}$	2	$6\frac{1}{7}$	2	$6\frac{2}{7}$	2	$6\frac{4}{7}$	2	$6\frac{6}{7}$
200	10	4	$11\frac{2}{7}$	4	$11\frac{5}{7}$	4	$12\frac{1}{7}$	4	$12\frac{5}{7}$	4	$13\frac{1}{7}$	4	$13\frac{5}{7}$
300	15	6	17	6	$17\frac{5}{7}$	7	$\frac{3}{7}$	7	$1\frac{1}{7}$	7	$1\frac{6}{7}$	7	$2\frac{4}{7}$
400	20	9	$4\frac{4}{7}$	9	$5\frac{4}{7}$	9	$6\frac{4}{7}$	9	$7\frac{3}{7}$	9	$8\frac{3}{7}$	9	$9\frac{3}{7}$
500	25	11	$10\frac{2}{7}$	11	$11\frac{3}{7}$	11	$12\frac{4}{7}$	11	$13\frac{6}{7}$	11	15	11	$16\frac{2}{7}$
600	30	13	16	13	$17\frac{3}{7}$	14	$\frac{6}{7}$	14	$2\frac{2}{7}$	14	$3\frac{5}{7}$	14	$5\frac{1}{7}$
700	35	16	$3\frac{4}{7}$	16	$5\frac{2}{7}$	16	7	16	$8\frac{4}{7}$	16	$10\frac{2}{7}$	16	12
800	40	18	$9\frac{2}{7}$	18	$11\frac{1}{7}$	18	13	18	15	18	$16\frac{6}{7}$	19	$\frac{6}{7}$
900	45	20	15	20	$17\frac{1}{7}$	21	$1\frac{2}{7}$	21	$3\frac{3}{7}$	21	$5\frac{4}{7}$	21	$7\frac{5}{7}$
1000	50	23	$2\frac{4}{7}$	23	5	23	$7\frac{3}{7}$	23	$9\frac{5}{7}$	23	$12\frac{1}{7}$	23	$14\frac{4}{7}$
2000	100	46	$5\frac{2}{7}$	46	10	46	$14\frac{5}{7}$	47	$1\frac{4}{7}$	47	$6\frac{2}{7}$	47	$11\frac{1}{7}$
3000	150	69	8	69	$15\frac{1}{7}$	70	$4\frac{2}{7}$	70	$11\frac{3}{7}$	71	$\frac{4}{7}$	71	$7\frac{5}{7}$
4000	200	92	$10\frac{4}{7}$	93	$2\frac{1}{7}$	93	$11\frac{5}{7}$	94	$3\frac{1}{7}$	94	$12\frac{5}{7}$	95	$4\frac{2}{7}$

Ells.		$144\frac{4}{5}$		$145\frac{3}{5}$		$146\frac{2}{5}$		$147\frac{1}{5}$		148		$148\frac{4}{5}$	
Yards.		181		182		183		184		185		186	
Splits.	Porters	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$		$1\frac{5}{7}$
5	$\frac{1}{4}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$		$2\frac{1}{7}$
10	$\frac{1}{2}$		$4\frac{2}{7}$		$4\frac{2}{7}$		$4\frac{2}{7}$		$4\frac{3}{7}$		$4\frac{3}{7}$		$4\frac{3}{7}$
20	1		$8\frac{4}{7}$		$8\frac{5}{7}$		$8\frac{5}{7}$		$8\frac{5}{7}$		$8\frac{6}{7}$		$8\frac{6}{7}$
30	$1\frac{1}{2}$		$12\frac{6}{7}$		13		13		$13\frac{1}{7}$		$13\frac{1}{7}$		$13\frac{2}{7}$
40	2		$17\frac{2}{7}$		$17\frac{2}{7}$		$17\frac{3}{7}$		$17\frac{4}{7}$		$17\frac{4}{7}$		$17\frac{5}{7}$
50	$2\frac{1}{2}$	1	$3\frac{4}{7}$	1	$3\frac{5}{7}$	1	$3\frac{5}{7}$	1	$3\frac{6}{7}$	1	4	1	$4\frac{1}{7}$
60	3	1	$7\frac{6}{7}$	1	8	1	$8\frac{1}{7}$	1	$8\frac{2}{7}$	1	$8\frac{3}{7}$	1	$8\frac{4}{7}$
70	$3\frac{1}{2}$	1	$12\frac{1}{7}$	1	$12\frac{2}{7}$	1	$12\frac{3}{7}$	1	$12\frac{5}{7}$	1	$12\frac{6}{7}$	1	13
80	4	1	$16\frac{3}{7}$	1	$16\frac{4}{7}$	1	$16\frac{5}{7}$	1	17	1	$17\frac{1}{7}$	1	$17\frac{3}{7}$
90	$4\frac{1}{2}$	2	$2\frac{5}{7}$	2	3	2	$3\frac{1}{7}$	2	$3\frac{3}{7}$	2	$3\frac{4}{7}$	2	$3\frac{6}{7}$
100	5	2	$7\frac{1}{7}$	2	$7\frac{2}{7}$	2	$7\frac{4}{7}$	2	$7\frac{5}{7}$	2	8	2	$8\frac{2}{7}$
200	10	4	$14\frac{2}{7}$	4	$14\frac{4}{7}$	4	$15\frac{1}{7}$	4	$15\frac{4}{7}$	4	16	4	$16\frac{4}{7}$
300	15	7	$3\frac{2}{7}$	7	4	7	$4\frac{5}{7}$	7	$5\frac{3}{7}$	7	$6\frac{1}{7}$	7	$6\frac{6}{7}$
400	20	9	$10\frac{2}{7}$	9	$11\frac{2}{7}$	9	$12\frac{2}{7}$	9	$13\frac{1}{7}$	9	$14\frac{1}{7}$	9	$15\frac{1}{7}$
500	25	11	$17\frac{3}{7}$	12	$\frac{4}{7}$	12	$1\frac{6}{7}$	12	3	12	$4\frac{2}{7}$	12	$5\frac{3}{7}$
600	30	14	$6\frac{4}{7}$	14	8	14	$9\frac{3}{7}$	14	$10\frac{6}{7}$	14	$12\frac{2}{7}$	14	$13\frac{5}{7}$
700	35	16	$13\frac{4}{7}$	16	$15\frac{2}{7}$	16	17	17	$\frac{4}{7}$	17	$2\frac{2}{7}$	17	4
800	40	19	$2\frac{5}{7}$	19	$4\frac{4}{7}$	19	$6\frac{4}{7}$	19	$8\frac{3}{7}$	19	$10\frac{2}{7}$	19	$12\frac{2}{7}$
900	45	21	$9\frac{6}{7}$	21	12	21	$14\frac{1}{7}$	21	$16\frac{2}{7}$	22	$\frac{4}{7}$	22	$2\frac{4}{7}$
1000	50	23	$16\frac{6}{7}$	24	$1\frac{2}{7}$	24	$3\frac{6}{7}$	24	6	24	$8\frac{3}{7}$	24	$10\frac{6}{7}$
2000	100	47	$15\frac{6}{7}$	48	$2\frac{4}{7}$	48	$7\frac{3}{7}$	48	$12\frac{1}{7}$	48	$16\frac{6}{7}$	49	$3\frac{5}{7}$
3000	150	71	$14\frac{6}{7}$	72	4	72	$11\frac{1}{7}$	73	$\frac{2}{7}$	73	$7\frac{3}{7}$	73	$14\frac{4}{7}$
4000	200	95	$13\frac{5}{7}$	96	$5\frac{2}{7}$	96	$14\frac{6}{7}$	97	$6\frac{2}{7}$	97	$15\frac{6}{7}$	98	$7\frac{3}{7}$

Ells.		$149\frac{3}{5}$		$150\frac{2}{5}$		$151\frac{1}{5}$		152		$152\frac{4}{5}$		$153\frac{3}{5}$	
Yards.		187		188		189		190		191		192	
Splits.	Porters	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{5}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$
5	$\frac{1}{4}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$
10	$\frac{1}{2}$		$4\frac{3}{7}$		$4\frac{3}{7}$		$4\frac{3}{7}$		$4\frac{4}{7}$		$4\frac{4}{7}$		$4\frac{4}{7}$
20	1		$8\frac{6}{7}$		9		9		9		9		$9\frac{1}{7}$
30	$1\frac{1}{2}$		$13\frac{2}{7}$		$13\frac{3}{7}$		$13\frac{3}{7}$		$13\frac{4}{7}$		$13\frac{4}{7}$		$13\frac{5}{7}$
40	2		$17\frac{6}{7}$		$17\frac{6}{7}$	1	0	1	$\frac{1}{7}$	1	$\frac{2}{7}$	1	$\frac{3}{7}$
50	$2\frac{1}{2}$	1	$4\frac{2}{7}$	1	$4\frac{3}{7}$	1	$4\frac{3}{7}$	1	$4\frac{4}{7}$	1	$4\frac{5}{7}$	1	$4\frac{6}{7}$
60	3	1	$8\frac{5}{7}$	1	$8\frac{6}{7}$	1	9	1	$9\frac{1}{7}$	1	$9\frac{2}{7}$	1	$9\frac{3}{7}$
70	$3\frac{1}{2}$	1	$13\frac{1}{7}$	1	$13\frac{2}{7}$	1	$13\frac{3}{7}$	1	$13\frac{5}{7}$	1	$13\frac{6}{7}$	1	14
80	4	1	$17\frac{5}{7}$	1	$17\frac{6}{7}$	2	0	2	$\frac{2}{7}$	2	$\frac{4}{7}$	2	$\frac{6}{7}$
90	$4\frac{1}{2}$	2	4	2	$4\frac{2}{7}$	2	$4\frac{3}{7}$	2	$4\frac{5}{7}$	2	$4\frac{6}{7}$	2	$5\frac{1}{7}$
100	5	2	$8\frac{3}{7}$	2	$8\frac{5}{7}$	2	9	2	$9\frac{2}{7}$	2	$9\frac{3}{7}$	2	$9\frac{5}{7}$
200	10	4	17	4	$17\frac{3}{7}$	5	0	5	$\frac{3}{7}$	5	$\frac{6}{7}$	5	$1\frac{3}{7}$
300	15	7	$7\frac{4}{7}$	7	$8\frac{2}{7}$	7	9	7	$9\frac{5}{7}$	7	$10\frac{3}{7}$	7	$11\frac{1}{7}$
400	20	9	16	9	17	10	0	10	1	10	$1\frac{6}{7}$	10	$2\frac{6}{7}$
500	25	12	$6\frac{4}{7}$	12	$7\frac{5}{7}$	12	9	12	$10\frac{1}{7}$	12	$11\frac{2}{7}$	12	$12\frac{4}{7}$
600	30	14	$15\frac{1}{7}$	14	$16\frac{4}{7}$	15	0	15	$1\frac{3}{7}$	15	$2\frac{6}{7}$	15	$4\frac{2}{7}$
700	35	17	$5\frac{4}{7}$	17	$7\frac{2}{7}$	17	9	17	$10\frac{5}{7}$	17	$12\frac{2}{7}$	17	14
800	40	19	$14\frac{1}{7}$	19	16	20	0	20	$1\frac{6}{7}$	20	$3\frac{5}{7}$	20	$5\frac{5}{7}$
900	45	22	$4\frac{5}{7}$	22	$6\frac{6}{7}$	22	$8\frac{5}{7}$	22	$11\frac{1}{7}$	22	$13\frac{2}{7}$	22	$15\frac{3}{7}$
1000	50	24	$13\frac{1}{7}$	24	$15\frac{4}{7}$	25	0	25	$2\frac{3}{7}$	25	$4\frac{5}{7}$	25	$7\frac{1}{7}$
2000	100	49	$8\frac{3}{7}$	49	$13\frac{1}{7}$	50	0	50	$4\frac{5}{7}$	50	$9\frac{3}{7}$	50	$14\frac{2}{7}$
3000	150	74	$3\frac{5}{7}$	74	$10\frac{6}{7}$	75	0	75	$7\frac{1}{7}$	75	$14\frac{2}{7}$	76	$3\frac{3}{7}$
4000	200	98	$16\frac{6}{7}$	99	$8\frac{3}{7}$	100	0	100	$9\frac{4}{7}$	101	1	101	$10\frac{4}{7}$

Ells.		$154\frac{2}{5}$		$155\frac{1}{5}$		156		$156\frac{4}{5}$		$157\frac{3}{5}$		$158\frac{2}{5}$	
Yards.		193		194		195		196		197		198	
Splits.	Porters	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		$1\frac{6}{7}$		2
5	$\frac{1}{4}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{2}{7}$		$2\frac{3}{7}$
10	$\frac{1}{2}$		$4\frac{4}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$		$4\frac{5}{7}$
20	1		$9\frac{1}{7}$		$9\frac{2}{7}$		$9\frac{2}{7}$		$9\frac{2}{7}$		$9\frac{3}{7}$		$9\frac{3}{7}$
30	$1\frac{1}{2}$		$13\frac{5}{7}$		$13\frac{6}{7}$		$13\frac{6}{7}$		14		14		$14\frac{1}{7}$
40	2	1	$\frac{3}{7}$	1	$\frac{4}{7}$	1	$\frac{4}{7}$	1	$\frac{5}{7}$	1	$\frac{6}{7}$	1	$\frac{6}{7}$
50	$2\frac{1}{2}$	1	$4\frac{6}{7}$	1	$5\frac{1}{7}$	1	$5\frac{1}{7}$	1	$5\frac{2}{7}$	1	$5\frac{3}{7}$	1	$5\frac{4}{7}$
60	3	1	$9\frac{4}{7}$	1	$9\frac{5}{7}$	1	$9\frac{6}{7}$	1	10	1	$10\frac{1}{7}$	1	$10\frac{2}{7}$
70	$3\frac{1}{2}$	1	$14\frac{1}{7}$	1	$14\frac{3}{7}$	1	$14\frac{4}{7}$	1	$14\frac{5}{7}$	1	$14\frac{6}{7}$	1	15
80	4	2	$\frac{5}{7}$	2	1	2	$1\frac{1}{7}$	2	$1\frac{2}{7}$	2	$1\frac{4}{7}$	2	$1\frac{5}{7}$
90	$4\frac{1}{2}$	2	$5\frac{2}{7}$	2	$5\frac{4}{7}$	2	$5\frac{5}{7}$	2	6	2	$6\frac{1}{7}$	2	$6\frac{3}{7}$
100	5	2	10	2	$10\frac{2}{7}$	2	$10\frac{3}{7}$	2	$10\frac{5}{7}$	2	11	2	$11\frac{1}{7}$
200	10	5	$1\frac{6}{7}$	5	$2\frac{2}{7}$	5	$2\frac{6}{7}$	5	$3\frac{2}{7}$	5	$3\frac{6}{7}$	5	$4\frac{2}{7}$
300	15	7	$11\frac{6}{7}$	7	$12\frac{4}{7}$	7	$13\frac{2}{7}$	7	14	7	$14\frac{5}{7}$	7	$15\frac{3}{7}$
400	20	10	$3\frac{6}{7}$	10	$4\frac{6}{7}$	10	$5\frac{5}{7}$	10	$6\frac{5}{7}$	10	$7\frac{5}{7}$	10	$8\frac{4}{7}$
500	25	12	$13\frac{5}{7}$	12	15	12	$16\frac{1}{7}$	12	$17\frac{2}{7}$	13	$\frac{4}{7}$	13	$1\frac{5}{7}$
600	30	15	$5\frac{5}{7}$	15	$7\frac{1}{7}$	15	$8\frac{4}{7}$	15	10	15	$11\frac{3}{7}$	15	$12\frac{6}{7}$
700	35	17	$15\frac{5}{7}$	17	$17\frac{3}{7}$	18	1	18	$2\frac{5}{7}$	18	$4\frac{3}{7}$	18	6
800	40	20	$7\frac{5}{7}$	20	$9\frac{4}{7}$	20	$11\frac{3}{7}$	20	$13\frac{2}{7}$	20	$15\frac{2}{7}$	20	$17\frac{1}{7}$
900	45	22	$7\frac{4}{7}$	23	$1\frac{5}{7}$	23	$3\frac{6}{7}$	23	6	23	$8\frac{1}{7}$	23	$10\frac{2}{7}$
1000	50	25	$9\frac{4}{7}$	25	11	25	$14\frac{2}{7}$	25	$16\frac{5}{7}$	26	$1\frac{1}{7}$	26	$3\frac{3}{7}$
2000	100	51	1	51	$5\frac{5}{7}$	51	$10\frac{4}{7}$	51	$14\frac{5}{7}$	52	$2\frac{1}{7}$	52	$6\frac{6}{7}$
3000	150	76	$10\frac{4}{7}$	76	$17\frac{5}{7}$	77	$6\frac{6}{7}$	77	14	78	$3\frac{1}{7}$	78	$10\frac{2}{7}$
4000	200	102	$2\frac{1}{7}$	102	$11\frac{5}{7}$	103	$3\frac{1}{7}$	103	$12\frac{5}{7}$	104	$4\frac{2}{7}$	104	$13\frac{5}{7}$

Ells.		$159\frac{1}{5}$		160		$160\frac{4}{5}$		$161\frac{3}{5}$		$162\frac{2}{5}$		$163\frac{1}{5}$	
Yards.		199		200		201		202		203		204	
Splits.	Porters	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk.	Sp.	Hk	Sp.	Hk.
2	$\frac{1}{10}$												
4	$\frac{1}{5}$		2		2		2		2		2		2
5	$\frac{1}{4}$		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$		$2\frac{3}{7}$
10	$\frac{1}{2}$		$4\frac{5}{7}$		$4\frac{6}{7}$		$4\frac{6}{7}$		$4\frac{6}{7}$		$4\frac{6}{7}$		5
20	1		$9\frac{3}{7}$		$9\frac{4}{7}$		$9\frac{4}{7}$		$9\frac{5}{7}$		$9\frac{5}{7}$		$9\frac{5}{7}$
30	$1\frac{1}{2}$		$14\frac{1}{7}$		$14\frac{2}{7}$		$14\frac{2}{7}$		$14\frac{3}{7}$		$14\frac{3}{7}$		$14\frac{4}{7}$
40	2	1	1	1	$1\frac{1}{7}$	1	$1\frac{2}{7}$	1	$1\frac{2}{7}$	1	$1\frac{3}{7}$	1	$1\frac{4}{7}$
50	$2\frac{1}{2}$	1	$5\frac{5}{7}$	1	$5\frac{6}{7}$	1	6	1	$6\frac{1}{7}$	1	$6\frac{1}{7}$	1	$6\frac{2}{7}$
60	3	1	$10\frac{3}{7}$	1	$10\frac{4}{7}$	1	$10\frac{5}{7}$	1	$10\frac{6}{7}$	1	11	1	$11\frac{1}{7}$
70	$3\frac{1}{2}$	1	$15\frac{1}{7}$	1	$15\frac{3}{7}$	1	$15\frac{4}{7}$	1	$15\frac{5}{7}$	1	$15\frac{6}{7}$	1	$16\frac{1}{7}$
80	4	2	$1\frac{6}{7}$	2	$2\frac{1}{7}$	2	$2\frac{2}{7}$	2	$2\frac{4}{7}$	2	$2\frac{5}{7}$	2	$2\frac{6}{7}$
90	$4\frac{1}{2}$	2	$6\frac{4}{7}$	2	$6\frac{6}{7}$	2	7	2	$7\frac{2}{7}$	2	$7\frac{3}{7}$	2	$7\frac{5}{7}$
100	5	2	$11\frac{3}{7}$	2	$11\frac{5}{7}$	2	12	2	$12\frac{1}{7}$	2	$12\frac{3}{7}$	2	$12\frac{5}{7}$
200	10	5	$4\frac{5}{7}$	5	$5\frac{2}{7}$	5	$5\frac{5}{7}$	5	$6\frac{2}{7}$	5	$6\frac{5}{7}$	5	$7\frac{1}{7}$
300	15	7	$16\frac{1}{7}$	7	$16\frac{6}{7}$	7	$17\frac{4}{7}$	8	$\frac{2}{7}$	8	1	8	$1\frac{5}{7}$
400	20	10	$9\frac{4}{7}$	10	$10\frac{4}{7}$	10	$11\frac{4}{7}$	10	$12\frac{3}{7}$	10	$13\frac{3}{7}$	10	$14\frac{3}{7}$
500	25	13	$2\frac{6}{7}$	13	$4\frac{1}{7}$	13	$5\frac{2}{7}$	13	$6\frac{3}{7}$	13	$7\frac{4}{7}$	13	$8\frac{5}{7}$
600	30	15	$14\frac{2}{7}$	15	$15\frac{5}{7}$	15	$17\frac{1}{7}$	16	$\frac{4}{7}$	16	2	16	$3\frac{3}{7}$
700	35	18	$7\frac{5}{7}$	18	$9\frac{3}{7}$	18	$11\frac{1}{7}$	18	$12\frac{6}{7}$	18	$14\frac{3}{7}$	18	$16\frac{1}{7}$
800	40	21	1	21	3	21	$4\frac{6}{7}$	21	$6\frac{5}{7}$	21	$8\frac{4}{7}$	21	$4\frac{4}{7}$
900	45	23	$12\frac{3}{7}$	23	$14\frac{4}{7}$	23	$16\frac{5}{7}$	24	$\frac{6}{7}$	24	3	24	$5\frac{1}{7}$
1000	50	26	$5\frac{6}{7}$	26	$8\frac{2}{7}$	26	$10\frac{5}{7}$	26	13	26	$15\frac{3}{7}$	26	$17\frac{6}{7}$
2000	100	52	$11\frac{4}{7}$	52	$16\frac{3}{7}$	53	$3\frac{1}{7}$	53	$7\frac{6}{7}$	53	$12\frac{4}{7}$	53	$15\frac{3}{7}$
3000	150	78	$17\frac{3}{7}$	79	$6\frac{4}{7}$	79	$13\frac{5}{7}$	80	$2\frac{6}{7}$	80	10	80	$17\frac{1}{7}$
4000	200	105	$5\frac{2}{7}$	105	$14\frac{6}{7}$	106	$6\frac{3}{7}$	106	$15\frac{6}{7}$	107	$7\frac{3}{7}$	107	17

When the manufacturer wishes to find, from the foregoing tables, the quantity of warp in a given piece of cloth, it can be done in the following manner :—Suppose the piece 80 yards long, and containing 2000 splits, the quantity of spyndles will be found opposite 2000 splits, and under 80 yards at page 412, to be 21 spyndles 3 hanks, or in all 381 hanks (as shown in another table). This 381 is divided by the size of the yarn, say No. 36, to find the weight.

EXAMPLE.

```
36)381(10 lbs. 9⅓ oz.
   36
   ——
    21
    16
   ——
   126
   21
   ——
   336
   324
   ——
    12
   ——
    36
```

This shows the weight of the warp to be 10 lbs. $9\frac{1}{3}$ oz. To this weight the allowances will require to be added, which is thought proper for shrinkage, waste, &c., as these tables are all made out nett, taking the hank as 840 yards, and 18 hanks to the spyndle. Our reason for not making allowance for waste, &c., in the tables is (as stated before), because no given amount could be fixed upon with any degree of accuracy, it altogether depending upon the quality of the yarn, and the kind of cloth to be woven, what the allowance should be.

The quantity of weft can also be found from the tables. After the warp is ascertained, the weft will be the same quantity as the warp, if the number of shots seen by the glass be the same as the number of warp threads seen, or what is called in the trade, even and even. Suppose the web to be a 14^{00}, with 14 shots, and the quantity of warp to be 56 spyndles, the quantity of weft will be the same. If the shots be more or less than 14, the number of spyndles will be in proportion, more or less; for instance, if there be 13 shots, then there will be one-fourteenth less, or 52 spyndles; if 15 shots, one-fourteenth more, or 60 spyndles; and so on for any other number of shots.

When the warper or beamer wishes to know the quantity of spyndles, or number of lbs., they can find them in the same manner as shown for the manufacturer; but, in general, the number of yards put on the beams by the warpers and beamers are greater than what is given in these tables; however, it is easy to get any number that may be desired. For example, if the beam contains 2000 yards, multiply the spyndles found under the number of 200 yards by 10, or add a cipher, and that will be the quantity of spyndles for 2000 yards.

It has been shown how the number of lbs. can be found when the spyndles are known; and if the weaver, who buys his yarn from the spinner in chains, wishes to ascertain if he has got the size ordered, all he has to do is to look up the length and number of splits in the table that are contained in the chain, and the spyndles will be seen. An example for this is given at page 34, under "Yarn in Chain."

To find the number of ends or splits in any given web, a table has already been published, which shows them at a glance, and it can be had on application from the Publisher of this Work.

RATING TABLES.

The annexed tables have been made out principally for the use of manufacturers in rating goods. They will save time, as the number of hanks can be found for any number of splits (or dents) without calculation. They have been made out for 100 yards, and no allowance is made for waste or shrinkage; for, as stated before, this allowance must altogether depend upon circumstances. If these tables had been made out to answer all the different lengths of cloth that are woven, they would have taken up far too much space; therefore 100 yards have been fixed upon as the most suitable number. The hanks are shown on a line with the splits. By dividing the hanks by the size of the yarn, the manufacturer will find the yarn required in lbs. Suppose we take the number 1500 splits, opposite it is 357 hanks, the quantity required for 100 yards with 1500 splits, and to find the number of spyndles in the web divide the hanks (357) by 18.

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
½		.83	115	27	2.66	270	64	2. 0
1		1.66	120	28	4. 0	275	65	3.33
2		3.33	125	29	5.33	280	66	4.66
3		5. 0	130	30	6.66	285	67	6. 0
4		6.66	135	32	1. 0	290	69	0.33
5	1	1.33	140	33	2.33	295	70	1.66
6	1	3. 0	145	34	3 66	300	71	3 0
7	1	4.66	150	35	5. 0	305	72	4.33
8	1	6.33	155	36	6.33	310	73	5.66
9	2	1. 0	160	38	.66	315	75	...
10	2	2.66	165	39	2. 0	320	76	1.33
15	3	4. 0	170	40	3.33	325	77	2.66
20	4	5.33	175	41	4.66	330	78	4. 0
25	5	6.66	180	42	6. 0	335	79	5.33
30	7	1. 0	185	44	.33	340	80	6.66
35	8	2.33	190	45	1.66	345	82	1. 0
40	9	3.66	195	46	3. 0	350	83	2.33
45	10	5. 0	200	47	4.33	355	84	3.66
50	11	6.33	205	48	5.66	360	85	5. 0
55	13	.66	210	50	...	365	86	6.33
60	14	2. 0	215	51	1.33	370	88	0.66
65	15	3.33	220	52	2.66	375	89	2. 0
70	16	4.66	225	53	4. 0	380	90	3.33
75	17	6. 0	230	54	5.33	385	91	4.66
80	19	.33	235	55	6.66	390	92	6. 0
85	20	1.66	240	57	1. 0	395	94	0.33
90	21	3. 0	245	58	2.33	400	95	1.66
95	22	4.33	250	59	3.66	405	96	3. 0
100	23	5.66	255	60	5. 0	410	97	4.33
105	25	...	260	61	6.33	415	98	5.66
110	26	1.33	265	63	0.66	420	100	...

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
425	101	1.33	580	138	0.66	735	175	...
430	102	2.66	585	139	2. 0	740	176	1.33
435	103	4. 0	590	140	3.33	745	177	2.66
440	104	5.33	595	141	4.66	750	178	4. 0
445	105	6.66	600	142	6. 0	755	179	5.33
450	107	1. 0	605	144	0.33	760	180	6.66
455	108	2.33	610	145	1.66	765	182	1. 0
460	109	3.66	615	146	3. 0	770	183	2.33
465	110	5. 0	620	147	4.33	775	184	3.66
470	111	6.33	625	148	5.66	780	185	5. 0
475	113	0.66	630	150	...	785	186	6.33
480	114	2. 0	635	151	1.33	790	188	0.66
485	115	3.33	640	152	2.66	795	189	2. 0
490	116	4.66	645	153	4. 0	800	190	3.33
495	117	6. 0	650	154	5.33	805	191	4.66
500	119	0.33	655	155	6.66	810	192	6. 0
505	120	1.66	660	157	1. 0	815	194	0.33
510	121	3. 0	665	158	2.33	820	195	1.66
515	122	4.33	670	159	3.66	825	196	3. 0
520	123	5.66	675	160	5. 0	830	197	4.33
525	125	...	680	161	6.33	835	198	5.66
530	126	1.33	685	163	0.66	840	200	...
535	127	2.66	690	164	2. 0	845	201	1.33
540	128	4. 0	695	165	3.33	850	202	2.66
545	129	5.33	700	166	4.66	855	203	4. 0
550	130	6.66	705	167	6. 0	860	204	5.33
555	132	1. 0	710	169	0.33	865	205	6.66
560	133	2.33	715	170	1.66	870	207	1. 0
565	134	3.66	720	171	3. 0	875	208	2.33
570	135	5. 0	725	172	4.33	880	209	3.66
575	136	6.33	730	173	5.66	885	210	5. 0

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
890	211	6.33	1045	248	5.66	1200	285	5. 0
895	213	0.66	1050	250	...	1205	286	6.33
900	214	2. 0	1055	251	1.33	1210	288	0.66
905	215	3.33	1060	252	2.66	1215	289	2. 0
910	216	4.66	1065	253	4. 0	1220	290	3.33
915	217	6. 0	1070	254	5.33	1225	291	4.66
920	219	0.33	1075	255	6.66	1230	292	6. 0
925	220	1.66	1080	257	1. 0	1235	294	0.33
930	221	3. 0	1085	258	2.33	1240	295	1.66
935	222	4.33	1090	259	3.66	1245	296	3. 0
940	223	5.66	1095	260	5. 0	1250	297	4.33
945	225	...	1100	261	6.33	1255	298	5.66
950	226	1.33	1105	263	0.66	1260	300	...
955	227	2 66	1110	264	2. 0	1265	301	1.33
960	228	4. 0	1115	265	3.33	1270	302	2.66
965	229	5.33	1120	266	4.66	1275	303	4. 0
970	230	6.66	1125	267	6. 0	1280	304	5.33
975	232	1. 0	1130	269	0.33	1285	305	6.66
980	233	2.33	1135	270	1.66	1290	307	1. 0
985	234	3.66	1140	271	3. 0	1295	308	2.33
990	235	5. 0	1145	272	4.33	1300	309	3.66
995	236	6.33	1150	273	5.66	1305	310	5. 0
1000	238	0.66	1155	275	...	1310	311	6.33
1005	239	2. 0	1160	276	1.33	1315	313	0.66
1010	240	3.33	1165	277	2.66	1320	314	2. 0
1015	241	4.66	1170	278	4. 0	1325	315	3.33
1020	242	6. 0	1175	279	5.33	1330	316	4.66
1025	244	0.33	1180	280	6.66	1335	317	6. 0
1030	245	1.66	1185	282	1. 0	1340	319	0.33
1035	246	3. 0	1190	283	2.33	1345	320	1.66
1040	247	4.33	1195	284	3.66	1350	321	3. 0

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
1355	322	4.33	1510	359	3.66	1665	396	3 .0
1360	323	5.66	1515	360	5. 0	1670	397	4.33
1365	325	...	1520	361	6.33	1675	398	5.66
1370	326	1.33	1525	363	0.66	1680	400	...
1375	327	2.66	1530	364	2. 0	1685	401	1.33
1380	328	4. 0	1535	365	3.33	1690	402	2.66
1385	329	5.33	1540	366	4.66	1695	403	4. 0
1390	330	6.66	1545	367	6. 0	1700	404	5.33
1395	332	1. 0	1550	369	0.33	1705	405	6.66
1400	333	2.33	1555	370	1.66	1710	407	1. 0
1405	334	3.66	1560	371	3. 0	1715	408	2.33
1410	335	5. 0	1565	372	4.33	1720	409	3.66
1415	336	6.33	1570	373	5.66	1725	410	5. 0
1420	338	0.66	1575	375	...	1730	411	6.33
1425	339	2. 0	1580	376	1.33	1735	413	0.66
1430	340	3.33	1585	377	2.66	1740	414	2. 0
1435	341	4.66	1590	378	4. 0	1745	415	3.33
1440	342	6. 0	1595	379	5.33	1750	416	4.66
1445	344	0.33	1600	380	6.66	1755	417	6. 0
1450	345	1.66	1605	382	1. 0	1760	419	0.33
1455	346	3. 0	1610	383	2.33	1765	420	1.66
1460	347	4.33	1615	384	3.66	1770	421	3. 0
1465	348	5.66	1620	385	5. 0	1775	422	4.33
1470	350	...	1625	386	6.33	1780	423	5.66
1475	351	1.33	1630	388	0.66	1785	425	...
1480	352	2.66	1635	389	2. 0	1790	426	1.33
1485	353	4. 0	1640	390	3.33	1795	427	2.66
1490	354	5.33	1645	391	4.66	1800	428	4. 0
1495	355	6.66	1650	392	6. 0	1805	429	5.33
1500	357	1. 0	1655	394	0.33	1810	430	6.66
1505	358	2.33	1660	395	1.66	1815	432	1. 0

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
1820	433	2.33	1975	470	1.66	2130	507	1. 0
1825	434	3.66	1980	471	3. 0	2135	508	2.33
1830	435	5. 0	1985	472	4.33	2140	509	3.66
1835	436	6.33	1990	473	5.66	2145	510	5. 0
1840	438	0.66	1995	475	...	2150	511	6.33
1845	439	2. 0	2000	476	1.33	2155	513	0.66
1850	440	3.33	2005	477	2.66	2160	514	2. 0
1855	441	4.66	2010	478	4. 0	2165	515	3.33
1860	442	6. 0	2015	479	5.33	2170	516	4.66
1865	444	0.33	2020	480	6.66	2175	517	6. 0
1870	445	1.66	2025	482	1. 0	2180	519	0.33
1875	446	3. 0	2030	483	2.33	2185	520	1.66
1880	447	4.33	2035	484	3.66	2190	521	3. 0
1885	448	5 66	2040	485	5. 0	2195	522	4.33
1890	450	...	2045	486	6.33	2200	523	5.66
1895	451	1.33	2050	488	0.66	2205	525	...
1900	452	2.66	2055	489	2. 0	2210	526	1.33
1905	453	4. 0	2060	490	3.33	2215	527	2.66
1910	454	5.33	2065	491	4.66	2220	528	4. 0
1915	455	6.66	2070	492	6. 0	2225	529	5.33
1920	457	1. 0	2075	494	0.33	2230	530	6.66
1925	458	2.33	2080	495	1.66	2235	532	1. 0
1930	459	3.66	2085	496	3. 0	2240	533	2.33
1935	460	5. 0	2090	497	4.33	2245	534	3.66
1940	461	6.33	2095	498	5.66	2250	535	5. 0
1945	463	0.66	2100	500	...	2255	536	6.33
1950	464	2. 0	2105	501	1.33	2260	538	0.66
1955	465	3.33	2110	502	2.66	2265	539	2. 0
1960	466	4.66	2115	503	4. 0	2270	540	3.33
1965	467	6. 0	2120	504	5.33	2275	541	4.66
1970	469	0.33	2125	505	6.66	2280	542	6. 0

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
2285	544	0.33	2440	580	6.66	2595	617	6 .0
2290	545	1.66	2445	582	1. 0	2600	619	0.33
2295	546	3. 0	2450	583	2.33	2605	620	1.66
2300	547	4.33	2455	584	3.66	2610	621	3. 0
2305	548	5.66	2460	585	5. 0	2615	622	4.33
2310	550	...	2465	586	6.33	2620	623	5.66
2315	551	1.33	2470	588	0.66	2625	625	...
2320	552	2.66	2475	589	2. 0	2630	626	1.33
2325	553	4. 0	2480	590	3.33	2635	627	2.66
2330	554	5.33	2485	591	4.66	2640	628	4. 0
2335	555	6.66	2490	592	5. 0	2645	629	5.33
2340	557	1. 0	2495	594	0.33	2650	630	6.66
2345	558	2.33	2500	595	1.66	2655	632	1. 0
2350	559	3.66	2505	596	3. 0	2660	633	2.33
2355	560	5. 0	2510	597	4.33	2665	634	3.66
2360	561	6.33	2515	598	5.66	2670	635	5. 0
2365	563	0.66	2520	600	...	2675	636	6.33
2370	564	2. 0	2525	601	1.33	2680	638	0.66
2375	565	3.33	2530	602	2.66	2685	639	2. 0
2380	566	4.66	2535	603	4. 0	2690	640	3.33
2385	567	6. 0	2540	604	5.33	2695	641	4.66
2390	569	0.33	2545	605	6.66	2700	642	6. 0
2395	570	1.66	2550	607	1. 0	2705	644	0.33
2400	571	3. 0	2555	608	2.33	2710	645	1.66
2405	572	4.33	2560	609	3.66	2715	646	3. 0
2410	573	5.66	2565	610	5. 0	2720	647	4.33
2415	575	...	2570	611	6.33	2725	648	5.66
2420	576	1.33	2575	613	0.66	2730	650	...
2425	577	2.66	2580	614	2. 0	2735	651	1.33
2430	578	4. 0	2585	615	3.33	2740	652	2.66
2435	579	5.33	2590	616	4.66	2745	653	4. 0

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
2750	654	5.33	2905	691	4.66	3060	728	4. 0
2755	655	6.66	2910	692	6. 0	3065	729	5.33
2760	657	1. 0	2915	694	0.33	3070	730	6.66
2765	658	2.33	2920	695	1.66	3075	732	1. 0
2770	659	3.66	2925	696	3. 0	3080	733	2.33
2775	660	5. 0	2930	697	4.33	3085	734	3.66
2780	661	6.33	2935	698	5.66	3090	735	5. 0
2785	663	0.66	2940	700	...	3095	736	6.33
2790	664	2. 0	2945	701	1.33	3100	738	0.66
2795	665	3.33	2950	702	2.66	3105	739	2. 0
2800	666	4.66	2955	703	4. 0	3110	740	3.33
2805	667	6. 0	2960	704	5.33	3115	741	4.66
2810	669	0.33	2965	705	6.66	3120	742	6. 0
2815	670	1.66	2970	707	1. 0	3125	744	0.33
2820	671	3. 0	2975	708	2.33	3130	745	1.66
2825	672	4.33	2980	709	3.66	3135	746	3. 0
2830	673	5 66	2985	710	5. 0	3140	747	4.33
2835	675	...	2990	711	6.33	3145	748	5.66
2840	676	1.33	2995	713	0.66	3150	750	...
2845	677	2.66	3000	714	2. 0	3155	751	1.33
2850	678	4. 0	3005	715	3.33	3160	752	2.66
2855	679	5.33	3010	716	4.66	3165	753	4. 0
2860	680	6.66	3015	717	6. 0	3170	754	5.33
2865	682	1. 0	3020	719	0.33	3175	755	6.66
2870	683	2.33	3025	720	1.66	3180	757	1. 0
2875	684	3.66	3030	721	3. 0	3185	758	2.33
2880	685	5. 0	3035	722	4.33	3190	759	3.66
2885	686	6.33	3040	723	5.66	3195	760	5. 0
2890	688	0.66	3045	725	...	3200	761	6.33
2895	689	2. 0	3050	726	1.33	3205	763	0.66
2900	690	3.33	3055	727	2.66	3210	764	2. 0

Split.	Hk.	Sk.	Split.	Hk.	Sk.	Split.	Hk.	Sk.
3215	765	3.33	3370	802	2.66	3525	839	2. 0
3220	766	4.66	3375	803	4. 0	3530	840	3.33
3225	767	6. 0	3380	804	5.33	3535	841	4.66
3230	769	0.33	3385	805	6.66	3540	842	6. 0
3235	770	1.66	3390	807	1. 0	3545	844	0.33
3240	771	3. 0	3395	808	2.33	3550	845	1.66
3245	772	4.33	3400	809	3.66	3555	846	3. 0
3250	773	5.66	3405	810	5. 0	3560	847	4.33
3255	775	...	3410	811	6.33	3565	848	5.66
3260	776	1.33	3415	813	0.66	3570	850	...
3265	777	2.66	3420	814	2. 0	3575	851	1.33
3270	778	4. 0	3425	815	3.33	3580	852	2.66
3275	779	5.33	3430	816	4.66	3585	853	4. 0
3280	780	6.66	3435	817	6. 0	3590	854	5.33
3285	782	1. 0	3440	819	0.33	3595	855	6.66
3290	783	2.33	3445	820	1.66	3600	857	1. 0
3295	784	3.66	3450	821	3. 0	3605	858	2.33
3300	785	5. 0	3455	822	4.33	3610	859	3.66
3305	786	6.33	3460	823	5.66	3615	860	5. 0
3310	788	0.66	3465	825	...	3620	861	6.33
3315	789	2. 0	3470	826	1.33	3625	863	0.66
3320	790	3.33	3475	827	2.66	3630	864	2. 0
3325	791	4.66	3480	828	4. 0	3635	865	3.33
3330	792	6. 0	3485	829	5.33	3640	866	4.66
3335	794	0.33	3490	830	6.66	3645	867	6. 0
3340	795	1.66	3495	832	1. 0	3650	869	0.33
3345	796	3. 0	3500	833	2.33	3655	870	1.66
3350	797	4.33	3505	834	3.66	3660	871	3. 0
3355	798	5.66	3510	835	5. 0	3665	872	4.33
3360	800	...	3515	836	6.33	3670	873	5.66
3365	801	1.33	3520	838	0.66	3675	875	...

CHAPTER X.

MISCELLANEOUS REMARKS CONNECTED WITH POWER-LOOM WEAVING.

ERECTING A NEW FACTORY.

Before commencing to build a power-loom factory, it is requisite for the projector to make considerable inquiry, to obtain knowledge concerning things that are likely to contribute to the success of the undertaking, such as feu-duty, or ground-rent, situation as to workers; coals, water; the market where the yarn is to be bought and the cloth sold; the form of the mill, the kind of boilers, engines, gearing, machinery, &c.

There is no doubt but a populous district is the best place for workers, and would be a good situation for a factory, provided there is no other obstacle to make the quantity of workers no object, such as the ground rent, local taxes, water, coals, &c., being so high in price as to make the work unprofitable; therefore, all the different circumstances must be taken into calculation. The carriage from and to the market where the yarn may be bought and the cloth sold, is not so expensive an item as it was before steam was taken advantage of for that purpose, and it often happens that the mills erected in country villages are as profitable as those in the large cities.

When the situation is fixed upon, plans of the whole should be drawn out by some party capable of doing it, under the direction of one who is thoroughly acquainted with power-loom weaving. After the plans are finished, and the quantity of looms ascertained that will be required to fill the work, the cost of the whole can be calculated.

It is at once apparent, that to conduct a factory for power-loom weaving profitably, it must be a certain size; the smallest should not be less than one tenter's charge; but even this is by far too small to do anything like a profitable business. A good size for giving an opportunity for our remarks would be a mill that could contain 720 looms, with the necessary preparation machines, &c.

The most approved form of a weaving factory is a ground flat or shed, built so as to be suitable for getting the machinery placed to the best advantage; some of the reasons given for the ground flat being preferred over the mill with four or five flats may be stated here. The loom, when bolted down upon heavy stones, works smoother. The carriage of the beams and yarn are done with less labour. The atmosphere is more favourable in the ground flat for weaving. The workers can be better arranged, and are all under the eye of the manager at the same time.

The following description gives the plans of what is considered a very good mill for 720 $\frac{4}{4}$ power-looms. The length of the shed inside is 206 feet, and the breadth 160 feet. The looms are placed across the house in eighteen rows, 40 looms in each row; this gives five feet for each loom, and six feet extra space at the end of the flat, where the beam racks, tenter's benches, &c., are placed. Allowing eight feet for each loom and passages, the eighteen rows will occupy 144 feet of the breadth of the flat, leaving sixteen feet at the one side, and the whole length of the flat for preparation machinery, storage, &c.

It is of the utmost importance to have the machinery and workers so arranged that no time will be lost in passing the goods from one place to another in the process of manufacturing. By attending to this it will add much to the advantage of the workers, and the profit of the establishment; because a constant communication is always going on between the different parts of the work, and what accelerates the progress of the work, by saving time, must be a benefit to all concerned. We will state here what is just now considered the best arrangement, but would advise beginners, or those intending to put up new works, to visit a number of factories already in operation before deciding upon any plan.

A wall is built the whole length of the shed, enclosing the looms from the other machinery, and this portion of the building is made two storeys or flats, which will be 16 feet wide and 206 feet long. A portion of the corner of the ground floor nearest the entrance to the factory is appropriated for the warehouse, with counting-house above, it occupying only a small portion of the second floor. Next to the counting-house is the warp-winders, then the warpers, and then the tape-leg dressers, all in the second floor. When the winders have got the bobbins filled, they are passed to the warpers; and when the warpers have got the beams filled, they are sent on to the dressers; and the dressed webs are lowered down to the under flat, at the opposite end from the warehouse, for the purpose of being drawn into the heddles, or twisted. From this place they pass into the weaving shed.

A portion of the under flat, next to the warehouse, is occupied as a store for furnishings required for the factory, and next to it is the yarn store, then the mechanics' shop, and, as stated before, the drawers and twisters are at the end of this under flat. This arrangement of the different places and machinery gives the least possible distance for any of the articles to be carried which are required in the manufacture of the cloth. The mechanic shop being at or near the centre of the mill, places it in the most convenient part for getting any repairs done to the machinery that may be required; and it is an advantage to the work to get the webs out of the dressing place as soon as they are finished, for the purpose of allowing them to cool before being put into the loom.

Ten or twelve feet from the mill, on this side of it, stand the engine-house and boilers. The furnaces of the boilers face the gate, through which the carts pass with the fuel. Behind the engine-house a small house is built, with two apartments; one is used for oil waste, and the other for a smithy. This completes the buildings, all except the chimney (or stalk), which should be built in some convenient place near to the boilers, and apart from the mill.

STEAM BOILERS.

There are so many different kinds of boilers in use for generating steam, for the purpose of driving the engine and heating the factory, that it is difficult to say which is the best. Some people approve of the vertical kind, which is composed of a series of tubes. Their advocates say they take up less room, and that they generate a given quantity of steam with less fuel than any other; and as the diameter of the tubes is comparatively small, they stand a greater pressure than the common kind, consequently less liable to burst.

Whatever kind of boilers the proprietors adopt, it is advisable to have them made so as they will stand at least a pressure of 100 lbs. to the square inch, and then they may be wrought with safety at 50 lbs. It is found to be a saving of fuel to work with high pressed steam for driving the engine, but for heating purposes it was at first found difficult to use; however, this is got over by reducing the pressure before it is allowed to go into the mill, and for this purpose an apparatus has been invented, and made by Mr. Auld, engineer, Glasgow, which does its work well. By using this apparatus a considerable saving is made, and every manufacturer by power should have them, as the temperature of the dressing flat can be kept at the desired degree of heat by making it self-acting.

It is also important that the boilers be kept clean. The number of times the boilers should be cleaned during one year's working will altogether depend upon the kind of water made use of; the best water is the purest, or that which contains the least amount of foreign matter, such as iron, magnesia, lime, &c; all of which are injurious to the boilers, by leaving a deposit or incrustation upon the plates of the boilers, not only corroding and weakening them, but also prevents the perfect absorption of the caloric by the water. To remedy this defect, when pure water cannot be profitably obtained, various expedients have been resorted to, but perhaps the best method is to have a small cistern below the boiler and connected to it, with a blow-off cock, the frequent use of which will go far to keep the boilers clean; and, if thought proper, the water blown off can be made use of again after the objectionable matter is deposited at the bottom of the cistern.

To prevent the radiation of heat from the boilers and the steam pipes connected to them, they ought to be well covered over with some non-conducting substance, such as hair felt. Every boiler should have a water and steam gauge; they are ornamental to the boilers, besides very useful, as the engineman, or any other person, can see the state of the water and steam in the boilers at a glance. If the proprietor or manager has a desire to see the state of the steam and water in the boiler, without going to the boiler-house, they can have the indicator in their private room, by having a small pipe led from the boiler into their room for the steam gauge, and a light chain for the water.

At first thought it may appear a little difficult to have the water gauge away from the boiler into another apartment, which may be at a higher level than the boiler itself, but it is very simple. The chain is attached to a float that is in contact with the water in the boiler (the float can be either inside the boiler, or in a tube for the purpose outside of it), and as the float will rise and fall with the water, it will give motion to the chain which causes the indicator to rise or fall in the manager's room. It can be so set that when the water is either too high or too low in the boiler, it will cause a bell to ring; and, as the manager will have occasion to be frequently out of his room, the bell may be made to ring until he returns, if he is not absent more than five or six hours. How this is accomplished is as follows:—The chain that is connected to the float is conveyed by pulleys from the float to the apartment, and from the floor of the apartment the chain passes up to the ceiling and over a pulley, and at this end of the chain a weight is hung, sufficiently heavy to draw the chain down when the float rises at the boiler. On that part of the chain that passes from the floor to the ceiling is fixed a rod of iron at right angles to the chain. The rod is four inches long, so that it projects on each side two inches from the centre of the chain. The projections move on the face of a brass plate, which is marked on the face in inches, corresponding to the water lines in the boiler, which will show at all times the state of the water in the boilers. If at any time the water is allowed to get too low, or too high, the iron rod that projects from the chain comes in contact with a catch, and lifts it out of gear from the wheel that drives the apparatus which rings the bell. Two bells are required, one for low water and one for high water; and the manager will see, when he returns to his room, which of the bells has been acted upon.

If this kind of indicator was more used, there would be less risk of the water becoming too low or too high in the boiler, because the man in charge of the boiler, knowing that he could not conceal his carelessness, would be more attentive. How to calculate for the weight to be put on the safety valve, to give a given pressure per square inch, will be seen in another place.

FURNACE—SMOKE-BURNING, &c.

To work engines economically, very much depends upon the construction and management of the furnaces. It would take up too much space to give even a mere outline of the different modes of furnaces that have been tried for the saving of fuel and the burning of smoke, and although no furnace does this to perfection, there are some that come very near it; and before giving a description of what is considered the best furnace, we will give an opinion of an eminent engineer upon prevention of smoke, to show the difficulties that have to be contended with.

He says, "I have approached this inquiry with considerable diffidence, and after repeated attempts at definite conclusions, have more than once been forced to abandon the investigation as inconclusive and unsatisfactory. These views do not arise from any defect in our acquaintance with the laws which govern perfect combustion, the economy of fuel, and the consumption of smoke. They chiefly arise from the constant change of temperature, the variable nature of the volatile products, the want of system, and the irregularity which attends the management of the furnace. Habits of economy and attention to a few simple and effective rules are either entirely neglected or not enforced. It must appear obvious to every observer that much has yet to be done, and much may be accomplished, provided the necessary precautions are taken—first, to establish; and next, to carry out a comprehensive and well-organised system of operations. If this were accomplished, and the management of the furnace consigned to men of intelligence, properly trained to their respective duties, all these difficulties would vanish, and the public might not only look forward with confidence to a clear atmosphere in the manufacturing towns, but the proprietors of steam engines would be more than compensated by the saving of fuel, which an improved system of management and a sounder principle of operation would ensure. The attainment of these objects—the prevention of smoke, and the perfect combustion of fuel—

are completely within the reach of all those who choose to adopt measures calculated for the suppression of the one and the improvement of the other."

It has been found, from a series of experiments made with the furnace about to be explained, that besides consuming the smoke (as near perfection as any yet in use), a considerable amount of saving was made in fuel; and it has proved highly successful in numerous instances where it has been applied. The peculiar arrangement of the serrated bars, together with the movement imparted thereto, effectually prevents the formation of clinkers, and at the same time introduces a large volume of air, which becomes thoroughly heated before it reaches the gaseous matters evolved from the fresh fuel, which are thus flashed into flame, and the invisible vapour only passes off from the chimney.

Supposing this furnace be applied to a common boiler, the brickwork of it is arranged in the ordinary way. The furnace-mouth and dead-plate are of the usual kind; the back end of the ash-pit is formed of a cast-iron plate; beneath the furnace bars on each side is a tubular shaft, which forms air passages; these shafts or air tubes are supported at the front end by curved brackets, from the dead-plate of the furnace. If found preferable, the front ends of the air-tubes may be supported on the inner side by a semi-circular pendent bracket, cast on the underside of the dead-plate, and outside by a corresponding movable support bolted up to the dead-plate. The back end of each air-tube passes through and rests in the cast-iron plate, which forms the end of the furnace and back-bridge.

The fire-bars are arranged across the furnace at right angles to its length, and rest upon the air-tubes. On the inner portions of the peripheries of the air-tubes are cast the laterally projecting teeth, which act as cams to raise each alternate fire-bar when the air-tube is turned partially round. The fire-bars are cast with laterally projecting teeth or serrations, the end teeth and one in the centre being made a little longer than the others, so that, when arranged on the air-tubes, the bars are placed close together, these teeth serving to give steadiness to the bars, and, at the same time, leave a sufficient space between the intervening teeth. Each tooth of one bar enters the corresponding recess of the contiguous bar, but the elongated teeth at the ends and centres are the only ones which touch the neighbouring bar. The bars next the inner end of the dead-plate, and also the back-plate, are made with shorter teeth, but the edges of these plates might be serrated to correspond with the front and back bars. The other bars are put into their places, and arranged parallel, filling up the longitudinal extent of the furnace to the back-plate, which forms part of the back bridge. The cams on the air-tubes are made with recesses at the central part of each, and these are arranged at such a distance asunder, that the lower part of each bar falls into one of these recesses on the one side, and at the other, into the space between the cams. From this arrangement, it follows, that if the air-tubes are turned partly round, each alternate bar will be raised up at the end next the tube acted upon.

When the furnace is working, the stoker, from time to time, lifts the bars, by moving the air-tubes, the result of which breaks up the fuel, allows the ash to fall through, and prevents the formation of clinkers. The raising of the bars, from time to time, has also the effect of causing a large body of air to pass into the fuel, and it is thus kept in a state of intense combustion. The arrangement of this furnace, with its double-back bridge and air-valve, along with the air-tubes, provides for the effectual combustion of the inflammable portion of the gaseous matter evolved, and this prevents the emission of visible smoke from the chimney. A description of this furnace, along with drawings of it, are given in the *Practical Mechanics' Journal*, for April, 1862.

With the present plan, it is next to impossible to consume the smoke entirely; but there is a way that would most effectually do away with the smoke that is made by the furnaces that are used for generating steam for driving the engines. To explain our plan, we will take Glasgow and suburbs for illustration.

Instead of driving the engines with steam, as at present, they would be driven by compressed air. It may be stated that driving engines with compressed air is not at all a new idea, for a number of engines are working at present, and have been working for years with compressed air instead of steam. The present steam engines require no alteration to drive them with air, for air is as elastic and compressible as steam, if not more so. What is wanted is the power to compress the air so as it will drive the engines. Where this power is to be got will now be explained.

It has been calculated that a greater power can be got from the Clyde, and its tributaries above Glasgow, than all the steam-engines put together in Glasgow and its suburbs require, and that this power could be taken advantage of to compress the air for the purpose of driving the engines. Suppose the first water-wheels to be erected at Bonnington Fall, which is the uppermost fall above Lanark. The power to be had from these wheels to be expended on working pumps, which would force the air through pipes into iron receivers (which may be called reservoirs), and from the Bonnington Fall all the way down the banks of the Clyde, wherever any fall occurs, have other water-wheels and reservoirs for the same purpose. All these reservoirs would be connected with pipes, and a main pipe would lead the compressed air into Glasgow to drive the engines. It will be evident that the pressure would be the same in all the reservoirs and pipes by their being all connected. This pressure might be from 100 to 200 lbs. per square inch, and each engine proprietor could have a reducing-valve to reduce the pressure to suit his engine. It would depend upon the number and capacity of the reservoirs what quantity of compressed air could be stored up, and that would require to be large, so as to take advantage of the water-power during the night when the engines are not working. But as the pressure of the air may be brought up to 200 lbs. per square inch in the reservoirs, before allowing it to blow off, and the engines to be driven, not requiring more than 50 lbs. per square inch, the space required for storage would be considerably lessened. Safety-valves would require to be put on all the reservoirs, and on some parts of the pipes, so that, whenever the pressure rose above the 200 lbs. the air would blow off, and this would prevent the vessels bursting. The above is a mere hint of particulars. How the plan could be carried out in all its details need not be entered upon here, but it may be mentioned that no new appliances would have to be invented for the carrying of it out.

It is very likely that the first question that will be asked about this way of driving is, "Will it pay?"

There is no doubt but it would pay, and pay well, if the land on the banks of rivers could be got at a moderate price. And taking for comparison the cost of other undertakings of a similar nature, such as the water-works for supplying the city, the outlaid capital should not be more than £1,000,000, and the income from the present engine proprietors will be, at least, £130,000 per annum; and it would be their interest to use the air instead of steam, as long as the price of fuel is not lower than what it has been for the last fifteen years. The working expense would be comparatively little after it was all started. These remarks about paying only apply to towns that are situated like Glasgow for a water-power to compress the air; for, if the power for compressing the air had to be taken from the rise and fall of the tides, the expense for putting up floating vessels to get the required power would be a great deal more. But any amount of power can be got, although expensive, from the tides.

After the foregoing had been written, Mr Bramwell delivered an address, at the meeting of the British Association at Brighton, upon the subject of coal, in which he alludes to how advantage might be taken of the tides for driving machinery. He says:—"Before the steam engine was so extensively used as it now is, the wind, the force of streams, and the force of the tide were all employed to give motive power." After making some remarks on the three forces, and how they might be employed, he gives the following:—"Before quitting the subject of finding sources of power other than steam, the section will perhaps permit me to remind them of what has been done in the town of Schaffhausen by a public-spirited inhabitant in the way of utilising the water-power of the Rhine, and of laying it on, so to speak, to every man's door. This has been accomplished by erecting turbines, which are worked by the river, and deliver their power to endless wire ropes carried over pulleys placed alongside the Rhine, the rope extending nearly from one end of the town to the other. This rope gives off power at the end of each street abutting on the river bank, and that power is conveyed along those streets by a shaft in a channel under the paving. Each manufacturer can make his own communication with these principal shafts, and thus obtain the power he may require."

I think it will be evident that the carrying of the power by ropes and shafts is not so good a plan as conveying the air through pipes, in the way it has been explained, for the purpose of driving the engines.

STEAM ENGINE.

When the size of the factory will admit of it, it is better to drive the machinery with two engines than with one, as the motion will be more regular and steady. It is impossible to have a good working loom with an irregular drive. The advantage to be gained by using two engines, besides the regular motion, is, that less fuel is required to drive the machinery. The two engines are connected in such a manner, that when the one has no power, the other will have its greatest power, and that the steam is made to enter the first cylinder at a high state of pressure. When the steam has done its work with the first engine, it enters the cylinder of the second; the cylinder of the second engine, having a capacity four times larger than the cylinder of the first, the steam is allowed to expand, consequently, the pressure will be only as one to four; but as this engine is connected to the condenser, it receives the advantage of the vacuum.

By using the steam for driving the engines, and connecting them as described above, very little of the steam is lost, and very little of the power is consumed driving a large fly-wheel, which would be requisite to regulate the motion if only one engine were employed. Also, when two or three are working together, and they are properly arranged, very little expense will be required for the water used for condensing the steam.

But it has not as yet been properly tested whether the high-pressure engine by itself, or the high-pressure and condensing engines combined, is the most economical for driving factories; that is, taking into consideration the first outlay for the extra price of the engines, and the cost of the water. In some places where the cost of the water is high, it is decidedly cheaper just to have the high-pressure engine alone. A great deal might be said concerning steam-engines, but a few hints are all that is requisite for our purpose.

All the working parts in connection with the engine should be regularly cleaned and oiled. The large journals should have self-acting oil-cups, which will save both time and oil. A steam-gauge, also a vacuum one, should be fixed in some conspicuous place in the engine-house to show the working state of the engine.

To give the manager or proprietor an opportunity of seeing the number of strokes the engines make in one hour, day, or week, an indicator for that purpose should be connected to the engines. This indicator should be one of those kinds that will show what day, and the hour of that day, the engines have been below or above their regular speed. If any accident happens which allows the engines to run far beyond their regular speed, there is a danger of something being broken, and, to prevent this, the governor should be so constructed that it will shut off the steam entirely. Few engines have this kind of governor; but it is better to prevent breakages than repair them; therefore, it is advisable for every engine proprietor to take the advantage of it.

GEARING.

Supposing the speed of the looms to be one hundred and fifty picks per minute, the shafts for driving them should make nearly that number of revolutions per minute, so that there may be very little difference between the diameter of the loom pulley, and the drum that drives it; and it is advantageous to have the speed of the shafts brought up to the number of revolutions required, as near the engine as possible, if it is not convenient to have it done at the engine. By having the shafts running at a high speed, shafting of a much lighter description will answer the same purpose, which will be a saving in the first cost when erecting a new mill. Before giving the calculations for common gearing, we will give a description of driving looms without belting.

DRIVING LOOMS WITHOUT BELTING.

The outlay for gearing and belts amounts to a considerable sum for a new work, and the expense in keeping up the belts after the mill is started has caused experiments to be made to ascertain how to do away with the present mode of driving looms. The most likely plan is to drive them with frictional gear, on the following system:—Suppose the flat or shed to have twenty looms in one row, and six rows in the breadth of the flat. This will require three shafts (which we will name long shafts) the whole length of the mill, these shafts being driven by a cross shaft at the end of the flat. Each of the long shafts will drive forty looms. The looms are set in the usual way—all in a straight line. These long shafts are supported with brackets, which are bolted to the ends of the looms, so that the long shaft will be on a level with the top shafts of the looms. For each pair of looms there is a bevel pulley on the long shaft, made in all respects the same as a bevel wheel without teeth. On the end of the top shaft of each loom there is a bevel pulley made to correspond to the one on the long shaft. This pulley on the loom shaft is made so as it can be shifted in or out of gear with the pulley on the long shaft. The handle of the loom is of the common kind, and the lever that is made to shift the belt in the usual way of driving, is made to act upon the back of the pulley on the loom shaft. When the loom is to be put in motion, the handle is pulled into the notch in the same manner as for a loom driven with a belt, and a sufficient strength of spring is given to the handle so as to press the pulley into contact with the other pulley to drive the loom. It will be obvious that the pulley on the loom shaft will require to be shifted a very small space for the purpose of putting it in gear with the other; therefore, a very small movement of the lever, at the pulley, is required, which makes the loom driven in this way easier put on than when driven with a belt.

This plan of driving looms will necessitate the long shafts to be boxed in where they cross the passes. This is no objection, but rather an advantage to the weavers, if it is properly done, as they will have a place for holding their weft boxes and cloth. Another very important advantage in this mode of driving looms is, that all danger of being caught with the belts is most effectually got quit of; in fact, it is at first cheaper, it is kept up with less expense, it is cleaner, because there is no teethed gear to throw out dirty grease, and it looks much neater. There are some trifling things connected with putting the pulley in and out of gear which have not been explained, but which will be apparent to any practical mechanic.

CALCULATION OF SPEEDS.

We propose to show briefly the method of calculating the speed of the different shafts and machines connected with a power-loom factory.

The first thing to be done is to find the speed of the engine, which is got by counting the number of strokes it makes during one minute. Each stroke of the engine is equal to one revolution of the first shaft; (and it may be remarked that most of the old engines are driven far too slow to get the full advantage out of them. Although engineers are not agreed among themselves about the proper speed that an engine should be driven at, we may state what speed has been found in practice to answer very well. An engine, with a five or six feet stroke, may be driven at the rate of 350 feet per minute, without any apprehension of danger by breakages).

For illustration: Suppose the crank shaft of the engine makes thirty revolutions per minute, multiply the number of teeth which is in the wheel on the crank shaft by the number of revolutions, and divide the product by the number of teeth in the pinion which gears into this wheel for driving the first shaft, and the answer will be the speed of the first shaft. The speed of the other shafts are found in the same manner, always multiplying the teeth in the driving wheel by the number of revolutions of the driving shaft, and dividing by the teeth in the driven pinion for the speed of the driven shaft; the driven shaft sometimes also becomes a driver, but this makes no difference in the mode of calculation. If the wheel on the crank shaft has 128 teeth, and the pinion on the first shaft 64 teeth, then the speed will be found as follows :—

EXAMPLE.

Number of teeth in driving wheel, 128
Speed of engine per minute, 30 strokes.

The number of teeth in pinion, 64)3840(60 speed of the first shaft.
384

But, as already stated, it is better to bring up the speed of the shafts as near the engine as possible; and for this purpose the pinion should have only 32 teeth, as in the following example :—

EXAMPLE.

Number of teeth in driving wheel, 128
Speed of engine per minute, 30 strokes.

The number of teeth in pinion, 32)3840(120 speed of the first shaft.
32

64
64

This wheel, with the 128 teeth, is made of sufficient weight so as no other fly-wheel is required for the engines. The first shaft passes from the engine-house to the weaving shed, and drives the long shaft, which we will call the second shaft, this second shaft being the one that drives the cross-shafts for the looms. On the other end of the first shaft is fixed a bevel wheel with 56 teeth, which gears with one on the second shaft of 50 teeth, this will make the speed of the second shaft to be 134·4 revolutions per minute.

EXAMPLE.

```
The first shaft makes per minute,          120  revolutions.
The number of teeth in driving wheel,       56
                                           ----
                                           720
                                          600
                                          -----
Number of teeth in the driven wheel,50)6720(134·4 speed of 2d shaft.
                                       50
                                       ---
                                       172
                                       150
                                       ---
                                        220
                                        200
                                        ---
                                         200
                                         200
                                         ---
```

By putting on metre wheels on the second and cross-shafts, the speed of the cross-shafts will also be 134·4 revolutions per minute. On these cross-shafts are hung the drums for driving the looms, and if the looms are to be driven at 150 picks per minute, and the driving pulleys of the looms be 11 inches in diameter, the diameter of the drum will be found by multiplying the speed of the loom by the diameter of the loom pulley, and dividing by the speed of the shaft.

EXAMPLE.

```
Speed of the loom per minute,   150   picks.
Diameter of loom pulley,         11   inches.
                               ─────
Speed of the shaft,      134·4)1650·0(12·27
                               1344
                               ─────
                                3060
                                2688
                                ─────
                                 3720
                                 2688
                                 ─────
                                 10320
                                  9408
                                  ────
                                   912
                                  ────
```

This shows the diameter of the drum to be 12·27 inches, to give the loom 150 picks per minute; but supposing the drum to be 14 inches in diameter, and the speed of the loom is required with a pulley 10 inches in diameter, multiply the speed of the shaft by the diameter of the drum in inches, and divide the product by the diameter of the loom pulley.

EXAMPLE.

```
Speed of shaft per minute,        134·4
Diameter of drum in inches,          14
                                  -----
                                   5376
                                  1344
                                 ------
Diameter of loom pulley,     10)18816(188·1   speed of loom.
                                10
                                --
                                 88
                                 80
                                 --
                                  81
                                  80
                                  --
                                   16
                                   10
                                   --
                                    6
```

We do not require to give examples how to find the speed of the shafts for driving the winding, warping, and dressing machine, as the same principle of calculating speeds applies to all. But the young inquirer may wish to know the speed that these different machines should be driven at. This very much depends upon the kind of work these machines have got to perform, and the quality and fineness of yarn that is used in the factory. Therefore, we would advise those who have not got practical experience, to get the opinion of some party who is thoroughly acquainted with weaving.

SAFETY VALVES

Are those valves that are placed upon the top of the steam boilers, or upon the steam chest, or dome, in connection with the boilers. For security, there should be more than one, as they are liable to get out of order; but our object is to give a simple rule how to find the weight that should be put upon the lever, to produce a given pressure upon a square inch. Suppose the surface of the valve, where the steam acts upon, to be six inches in diameter, multiply the diameter of the valve, which is six inches, by six, and the product by ·7854, and, after taking off the four figures to the right hand, the remainder is the number of square inches contained in the valve, 6 × 6 is 36.

EXAMPLE.

```
 ·7854
    36
 -----
 47124
23562
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28·2744
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This shows 28 square inches to be in the valve after throwing off the fraction; and suppose that 30 lbs. to the square inch is required, then 28 × 30 is equal to 840 lbs., the weight required for a valve of six inches in diameter. When it can be conveniently done, it is safer not to use a lever; but if a lever is to be used it must be taken into calculation.

QUADRANT.

A Quadrant, as used by weavers, is an instrument for weighing yarn to find its size; they are made for 1 hank, 8 hanks, or 16 hanks. It is divided into a certain number of parts, and each part is numbered to show the size of the yarn. Every manufacturer should have one of them, or a small beam and scale, with proper weights, which are by some considered preferable.

COLOURS.

Some pattern-drawers prefer to make up their own colours, and for those who wish to do so, we give the following statements, which are copied from an article on Drawing:—

REDS.

Vermillion.—This is a bright scarlet pigment, formed of common sulphur and quicksilver. When found in its natural state, it is called native cinnabar, but fictitious cinnabar when produced by a chemical process.

Red Lead is merely lead calcined to a higher degree than orange lead, by exposing it with a larger surface to the fire.

Scarlet Ochre is the ochrous earth, or rather iron, which is the basis of green vitriol, separated from the acid of the vitriol by calcination. It is of a broken scarlet colour, and stands well.

Common Indian Red is of a hue verging on scarlet, but the true Indian red is greatly inclining to purple.

Venetian Red is a native red ochre, rather inclining to scarlet.

Carmine affords the brightest and most perfect crimson, and is the most beautiful of all reds. It is produced from the tinging substance of cochineal, brightened with aquafortis, by a process similar to that used for dyeing scarlet in grain. It produces a variety of fine tints, from the deepest crimson to the highest pink. It is mixed with the spirits of hartshorn, and reduced to the requisite shades with water.

ORANGE.

This colour is usually a compound of some of the red and yellow pigments. Orange lead, which is ceruse calcined to a higher degree than masticot, is a fine bright orange, works very freely on design paper, and is commonly employed in designing patterns of only one colour.

BLUES.

Ultramarine is a preparation of calcined lapis lazuli. It is an extreme bright blue colour, but it is both high priced, and often adulterated.

Prussian Blue is the fixed sulphur of animal or vegetable coal, combined with the earth of alum. It is a very useful pigment, both in sketching and designing.

Verditer is a fine light blue, formed by a mixture of chalk and precipitated copper. It is without transparency, and is much employed both in sketches and designs.

Indigo is a tinging matter extracted from certain plants, by means of putrefaction and a coagulation by the air.

Bice is smalt, which is glass-coloured with zaffer, reduced to a fine powder by levigation.

Litmus is a blue pigment brought from abroad, and formed from archil, a species of moss brought from the Canary and Cape de Verd Islands.

GREENS.

Green is a compound colour, commonly made by mixing some of the yellow and blue pigments. The following, however, are simple greens :—

Verdigris is a rust or corrosion of copper, formed by the action of some vegetable acid. It is dissolved in vinegar.

Distilled Verdigris is the salt produced by the solution of copper, or common verdigris in vinegar. It makes a fine light green, both for sketching and designing.

Sap Green is the concrete juice of the buckthorn berries expressed from them.

YELLOWS.

Gamboge is a gum brought from the East Indies. It requires no preparation, but dissolves immediately on rubbing it, with the addition of water. It is a fine transparent yellow.

King's Yellow is orpiment, or arsenic, coloured with sulphur. It is poison, and ought to be used with caution. It is a good body colour, and, when mixed with blue pigments, makes a good green.

Yellow Ochre is a mineral earth, which is found in different degrees of purity. It is a good standing colour.

Masticot or Massicot is ceruse or flake white calcined by a moderate fire, but it requires a lighter or deeper tint according to the degree of calcination.

Chrome Yellow is a preparation of mercury by calcining it together with oil of vitriol. It is a good bright body colour. Mixed with Prussian blue it makes a fine green. Good yellows are also procured from French berries, saffron, and turmeric, by dissolving either of them in water; but, in order to preserve the bright tincture of the turmeric, it must be dissolved in spirits of wine.

BLACK.

Lamp Black is the soot of rosin received in sheepskins, or pieces of coarse linen fixed at the top of a chimney, where it is burnt for that purpose. To prepare it for use, put a small quantity on an iron shovel, or in the bowl of a tobacco pipe, and set it over the fire, when it will begin to smoke. When the smoking ceases, the black will be freed from the oily substance with which it was originally combined, and when mixed with gum will be fit for use.

IVORY BLACK is ivory burnt between two crucibles, and requires to be well ground with water before it is used in fine painting.

SPANISH BLACK is burnt cork.

CHERRY and PEACH STONES, and other vegetable substances, when charred in a covered crucible, make likewise excellent black pigments.

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