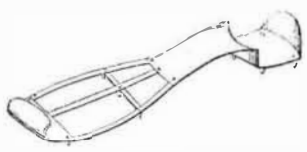
Fig. 5 shows a boot sole with steel calks attached, for the use of pedestrians in winter weather or when scaling the snowy tops of mountains or crossing glaciers. These calks are readily arranged to screw into plates fastened to the sole and heel of the boot, and are then removable at will. In walking over ice, these or similar appliances are indispensable; and many bruises, and sometimes limbs and even lives, have been saved by their use.

Fig. 5.



Boot-Calk.

Correspondence.

Employers and Trade Unions in England.

To the Editor of the Scientific American:

Intelligence having been received from England that the Amalgamated Society of Engineers is in dispute with the employers, on the question of the re-introduction of the system of piecework, which dispute has culminated in one strike, with the probability of the occurrence of others, I take the opportunity of ventilating this question a little, premising my remarks by stating that they are based upon personal knowledge of the actual facts. As a rule the editors of newspapers have very little mercy upon trades' unions, and this has been often said to be because the interests of newspapers lie with the employers of labor. This I believe to be a mistake, for even a mechanical newpaper has as large a circulation among workmen as it has among employers. The truth is rather that employers are more apt to avail themselves of the press, to present their side of the question to the public, and workmen are not usually skillful as writers or as special pleaders. Furthermore, editors, having no knowledge of the real evils of piecework (for piecework has its evils), and not being enlightened thereon by the workmen themselves, whose interest it is to ventilate that side of the question only, cannot be expected to form an equitable judgment upon the issues involved.

All the real causes of the opposition of trades' unions to the introduction of piecework will be found to be elucidated in the following recital of facts, in which it will be made apparent that, between employers and employed, there is, so far as abstract justice between them is concerned, but little to choose, and that the balance, if any there be, is decidedly in favor of the workmen, excepting in so far as acts of violence are concerned; and the occurrence of these acts is due only to the fact that a strike or lockout renders the condition of the workman a positively desperate one, whereas to the employer it is a mere question of his capital lying idle.

Public opinion is largely influenced by the publications of such works of fiction as Charles Reade's "Put Yourself in his Place," in which injustice is done to the workman, not in describing the terrible deeds which have been wrought by one workman on another, but by gathering together isolated cases of extreme violence, and attributing them all to the hero. This was perhaps a necessity for the author, in order to give this book the flavor of sensation necessary to the success of such works. But the excuse for the author by no means debars the artisan or trades' unionist from protesting against the injustice he sustains at the hands of the writer, whose impression on the public mind, by the description of such outrages, is grossly partial.

Towards the end of the year 1860, a young man who had been in business in South America and had returned to England, was re-engaged in the workshop in which he had served his apprenticeship; and having himself been an employer, he resolved to so perform his duties as a workman that he would prove to others that a good workman had only to study the interest of his employers to secure promotion. He wished to demonstrate that employers were watchful of those who were capable and who studied their interests, that the interests of the two were bound up together, and that the success of the one involved the success of the other; but alas! his employers were a railroad company, and that companies have no souls was amply "proven in the sequel." Labor was, in the estimation of this workman, a commodity whose value, like that of any other article, was just what it would fetch, its price being regulated by the quantity and quality delivered, and varying with the same. It was, therefore, not very encouraging to him to be told that it did not matter how much work he did, nor how well he did it, and that his wages at starting could not in any event exceed £1.12s per week, for that was the highest price paid to a new hand. That labor was not, therefore, the same as an article of merchandise, became to him at once painfully apparent; as it is not a rule of trade to pay less for an article because it is the first time you have purchased such a thing. There was nothing for it, however, but to accept the situation, and trust to time to obtain a higher rate of pay in the future. However, time passed, on, and the workman found no improvement in his condition until at last it was decided to have much of the work done by piecework. Accordingly a set of engine connecting rods were set aside to be fitted up by piecework, and some dozen workmen were selected and invited to give an estimate of what they would do the job for; and the young man in question, whom we will call Tom, gave the lowest bid and took the work, the price being sufficiently below the ordinary cost to be satisfactory to the managers. A set of axle boxes, other sets of rods, and several other jobs were done by Tom under similar conditions, he earning as much again as his day's work wages. This caused a sharp competition, as other workmen, anxious to better their condition, gave in lower prices; Tom, however, kept the lead, always managing by shrewdness, luck, or whatever else it may be termed, to take every job he bid for. Nothing daunted, however, his fellow workmen continued to compete, thus compelling Tom to either reduce his prices or lose the work. Some of the competitors bid because they would be satisfied if, by working piecework, they could increase their pay only twenty-five per cent; others competed upon general principles, saying that, if Tom could do it, they could. At length, however, Tom's repeated success discouraged competition, not, however, without raising some little feeling among the men, on account of his having, as was charged, cut the prices of the work down. This charge was scarcely fair, since it was in consequence of the competition of others that the prices had been reduced. It cannot, however, be denied that, since Tom was always the lowest, he was the most instrumental in the reduction of prices, notwithstanding the fact that his price was as a rule remarkably close to the next lower one. But the feeling among the men did not amount to positive estrangement, and it only found vent in upbraiding Tom by statements that he was ruining the trade and injuring the other workmen. At length, however, Tom began to make from 60 to 70 per cent more than his day's wages would have been: and this notwithstanding that the prices of his work had been very materially reduced since the piecework began. He innocently believed that the unusually low cost of his work, and the unusually large amount of his earnings, would open the eyes of his employers to his expertness, to the methods by which he saved time and work, or to whatever other cause may have enabled him to do so well. How far this was the case, he learned by an intimation that the prices of his work must be rednced because *no piecework man was allowed in that shop to earn more than* 50 *per cent more than his ordinary daily wages.* He pleaded that the cost of his work was at least 50 per cent less than the large quantity of the same kind of work being done in the same shop by men who had had from 7 to 15 years' experience on it. He was told it didn't matter what time the day's work men had taken, nor what their work had cost, or was now costing; he was making *too much money,* and must reduce his prices. He urged that, since no one else would take the work at so low a price as his, he could not perceive why he should be called upon to still further reduce the price; and he was informed that he must either reduce the prices of all those kinds of work on which he earned more than 50 per cent above ordinary day's wages, or else he would be put back to day's work on his old day wages; and as an alternative he had to reduce the prices.

Now, this was not a new shop, or one in which a constant change of work was had; but, on the contrary, there had probably never been, at any one time during the then preceding 15 years, less than 70 workmen in that shop who were employed on the same kind of work, many of whom had been engaged for years on precisely the same jobs from the selfsame drawings. Tom learned from the old hands that similar rules with regard to the amount of earnings of piecework men existed throughout England, that the rules were a sort of tacit understanding, and that as a consequence piecework men who had any wisdom in them gaged it so as to never exceed the allotted amount of "time and a half," as it is called.

At this time Tom's reflections were anything but rose-colored, as he had commenced with the idea of being an example to other men and a student of his employers' interest; but although he had practically demonstrated the identity of interests of the employer and the employed, he had advanced sufficiently far in his programme to be on questionable terms with many of his fellow workmen, and at loggerheads with his employers. His situation, so far as his personal relations with his business acquaintances were concerned, threatened ostracism; he felt almost like a criminal, and was only consoled by the consciousness that, in his own mind, he could not believe that doing a large amount of labor for an unusually small price, which is perhaps the most severe language in which his struggle to better his condition can be termed, deserved the meted punishment. "So much work for so much money," and "the more the work, the more the money," sounded exceedingly well as aphorisms; but when the workmen shouted: "No extra work, and no extra pay," and the employer added: "No more pay, however much more work you may do," and (in the same breath) "*less pay for more work for you only,*" it became exceedingly difficult for Tom to put his theory of identity of interests into any sort of practice. Tom found himself, according to the ordinary rules of commerce, the very worst paid man in the shop. In every article (as his work may be termed) he sold, he obtained a less price than any one else, and was at the same time grumbled at and virtually punished by the purchaser (his employer), because he had so many articles to sell; while that same purchaser was buying the same quality and kind of articles from others on the same spot at a much higher price. He, however, resolved to persevere in his course, and let the future take care of itself, with such results as I will describe in another letter. PIECEWORK.

New York city.

A SIMPLE mode of roughing horses, practised in Russia, consists in punching a square hole in each heel of the shoe, which, in ordinary weather, may be kept closed by a piece of cork. When the ground is slippery, the cork is removed, and a steel spike inserted. If this steel rough be made to fit the hole exactly, it remains firm in its place, and is not liable to break off short at the neck, like some of the screwed spikes.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

NUMBER XLI

TO DIVIDE A CIRCLE INTO ANY NUMBER OF EQUAL PARTS.

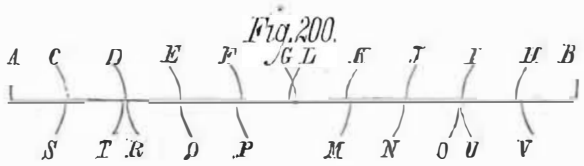
When a circle requires to be marked with a number of holes equidistant from each other, it is a very difficult matter to set the compasses so that, commencing at any one point and marking off the centers of the holes continuously in one direction, the last center marked will come true with the one first marked: because, if the points of the compasses are only one half the thickness of a line out, the error becomes, supposing the circle to require 60 holes around it, 60 times as great in the distance between the center last marked and the starting point.

The consequence is that it is almost impracticable to mark off any large number of holes in such a manner, not only on account of the frequent trials necessary to obtain so fine an adjustment of the compass points, but because the frequent trials will leave upon the surface of the work so many compass marks that those last made become almost indistinguishable from the other and incorrect ones. By the following method, however, such holes may be marked off, sufficiently correctly for all practical purposes, and more expeditiously than by any other means:

Let us suppose that it is required to mark off 60 equidistant holes upon a circle 30 inches in diameter. Our first procedure will be to ascertain at about what distance to set the compasses, so as to be nearly correct at the first trial. The most natural way would be to find the circumference of the circle, which is 94·248, and divide it by the number of holes, 60, which will give us 1 5708 as the distance between the centers of neighboring holes. The difficulty, however, of setting the compasses to the distance represented by the decimal fraction becomes apparent; and though this plan gives as near a result as any that can be arrived at, even in those cases in which the diameter of the circle may contain fractions of an inch and the number of holes required may be an odd one, still, in the matter of our example and, in fact, in all circles of whatever diameter, if the required number of holes is even, we may adopt a much better plan as follows:

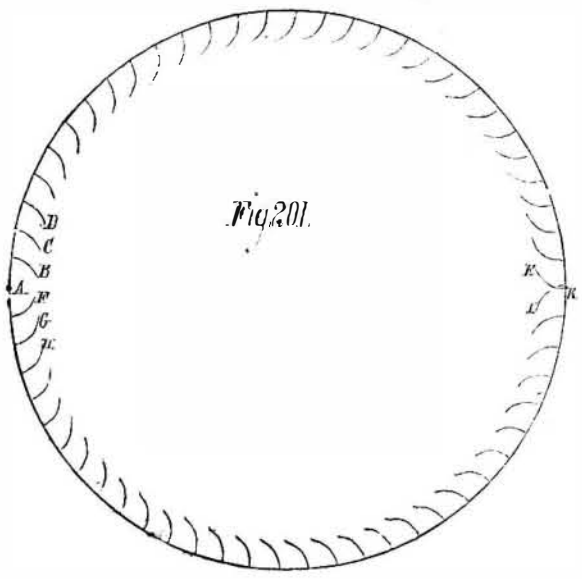
We know that the radius of any circle will divide its circumference into six equidistant points; and since we require ten times as many of such points, we have only to divide the radius of our circle into 10 equal parts to get the required distance, between the compass points, more correctly than by any other method. In many cases a simple mental calculation will give us the required distance. If, for example, our 30 inch circle requires to be divided into 18 equidistant points, we would say: If the radius (15 inches) of the circle gives us 6 points, one third of it, 5 inches, will give us 18 holes. Such instances are, however, the exceptions; and it is therefore necessary, in all cases where the required number of holes or points is an odd one, to divide the circumference by their number; and if an even number be required, to divide it into the radius of the circle, which may be done readily enough if the number of holes is small, but if they are many, the following method is the most expeditious: In Fig. 200, let A B represent the radius, 15 inches, of

Fig. 200.



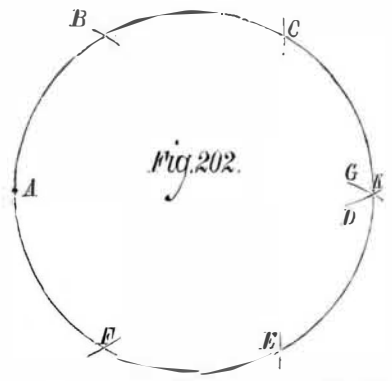
our circle, and therefore the distance between any two points when the circle is marked off into 6 equal divisions. It is apparent, then, that each of such divisions will require to contain ten equidistant points, which we mark off as follows: Setting the compasses as near as practicable to $\frac{1}{10}$ of the radius of our circle, we commence at A, and mark on one side of the line only the line, C, and from that the line, D, and so on up to G. Then recommencing at B, we mark off in like manner the lines, H, I, etc., up to L, and the exact center between the lines, G and L, will be the true position for the center hole, notwithstanding that none of the other points are in their proper positions, nor at proper distances apart. We now note that, as the lines, G and L, overlap one another, the compass points were a shade too wide open. This defect we remedy to the best of our judgment; and starting from the center point, between L and G, we mark off the lines, M, N, and O, on one side, and P, Q, and R, on the other. Then commencing again at A, we mark off the lines, S and T, and then from B, the lines, U and V: the junction of the lines, T and R, forming another true point, and that of O and U forming another, the fifth practically true division. It will be readily observed that, by marking the lines, from C to L, on one side only of the line representing the radius of our circle, and then subsequently marking the lines, from O to V, on the other side only of the said radius line, we keep them distinct, and are enabled readily to perceive the difference between them. For all ordinary purposes our compasses will now be set sufficiently exactly; but if a greater number of holes be required, we make a light centerpunch mark at the points, A and B, and at the junction, in the center of the nearest approach of the lines, T, R, O, and U; and rubbing out or chalking over all the lines save the one representing the radius, we proceed as above to mark out other holes to justify the compass points' distance. The centerpunch marks, however, should be made very lightly, and all of about one depth. If this second adjustment is necessary, it may be concluded by commencing at A and continuing on to B, so as to have the longest possible distance for the justification.

Whenever the number of holes required is a multiple or divisor of the diameter of the circle, we may obtain the first approximate distance of the compasses as follows: Every inch of the diameter of the circle represents 3·1416 inches of its circumference; and since, in our example, the diameter of the circle is supposed to be 30 inches and the number of holes required is 60, it is evident that every 3·1416 inches of the circumference will have to contain 2 holes; and therefore 3·1416÷2 = the proper distance of the compass points. Had the number of holes required been 30 instead of 60, their distance from center to center would be 3·1416 inches, while had their number been 15 their distance from center to center would be 6·2832. Now supposing the compasses to be set as nearly as possibly correctly, we proceed upon our circle as follows: Commencing at A, Fig. 201, we mark off

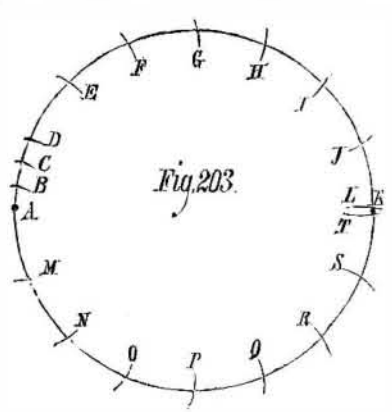


continuously one from the other, and taking care to be very exact in placing the point of the compasses exactly on the mark at its junction with the circle) the 30 points, B, C, D, etc , ending at E. Then commencing again at A, we mark off continuously and equidistantly the 30 marks, F, G, H, etc , ending at T; and the center, K, between the two lines, E and I, will be the true position of the point diametrically opposite to the point, A, from which we started.

It will be perhaps observed by the reader that it would be more expeditious and perhaps cause less variation were we to set the compasses to the radius of the circle and mark off the point, K, as shown in Fig. 202, commencing at the point,

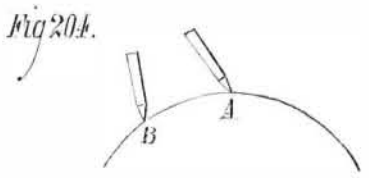


A, and marking off on the one side the lines, B, C, and D, and on the other side, E, F, and G, the junction or center, between G and D, at the circle being the true position of the point, K. For circles struck upon flat surfaces, this plan is decidedly advantageous; and in cases where there are not at hand compasses large enough, a pair of trammels may be used for the purpose; but our instructions are intended to apply also to marking off equidistant points on such circumferences as the faces of pulleys or on the outsides or insides of rings or cylinders, in which cases the use of compasses or gages is impracticable. The experienced hand may, it is true, adjust the compasses as instructed, and mark off three or four of the marks, B, C, D, etc., in Fig. 201, and then open out the compasses to the distance between the two extreme marks, and proceed as before to find the center, K, but as a rule, the time saved will scarcely repay the trouble; and all that can be done to save time in such cases is, if the holes come reasonably close together, to mark off, after the compasses are adjusted, three or four spaces, as shown in Fig.

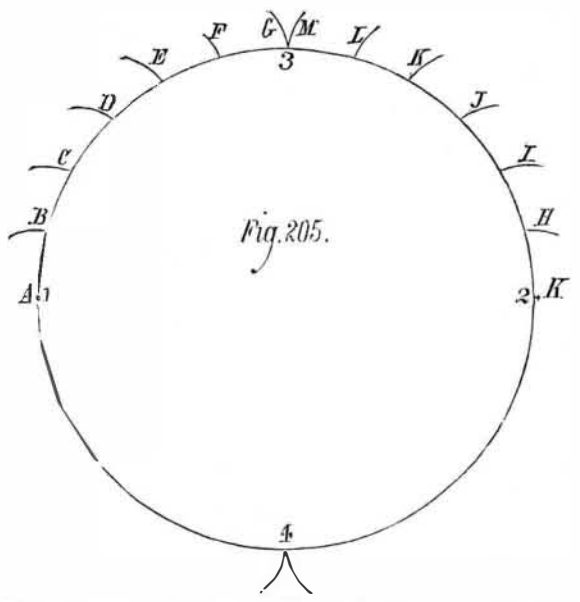


203. Commencing at the point, A, and marking off the points, B, C, and D, we then set the compasses to the distance between A and D, and then mark, from D on one side and from A on the other, the marks from F to L and from M to T: thus obtaining the point, K. This method, however expeditious and correct for certain work, is not applicable to circumferential work in which the distance between two of the adjacent points is at the most $\frac{1}{20}$ of the circumference of the circle; because the angle of the surface of the metal to the compass point causes the latter to spring wider open in consequence of the pressure necessary to cause the compass point to mark the metal. This will be readily perceived on reference to Fig. 204, in which A represents the stationary, and B, the scribing or marking point of the compasses.

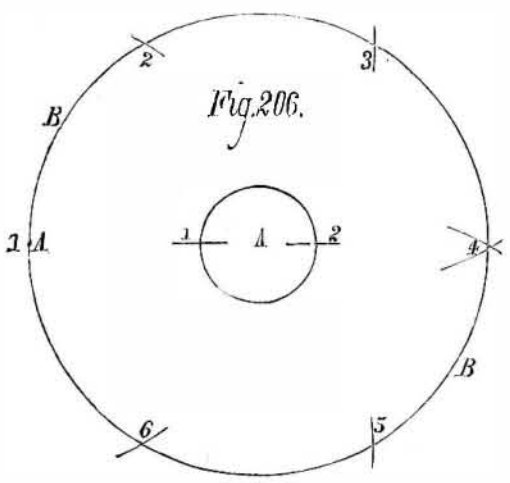
Having found the two diametrically opposite points, A, K, we note how much out of true the two lines last marked, E and I, in Fig. 201, vary, and we alter the compass points (in this case) to $\frac{1}{60}$ of the variation, that is, we divide the amount, of the variation between them, by the number of holes or points required; and setting our compasses as nearly as our judgment dictates, we mark off our next two points, as shown in Fig. 205 Commencing at A, we mark off (on the other



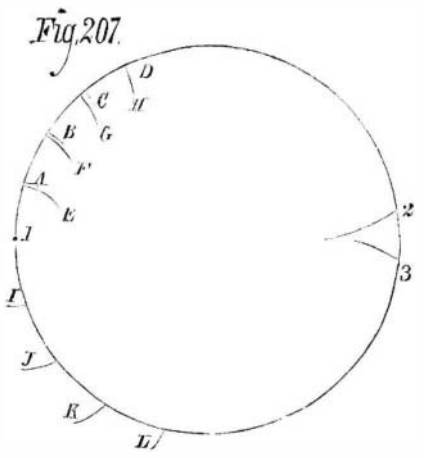
side of the circle, so as to keep them distinct from the marks previously made) the lines, B, C, etc., as far as the line, G that is to say, we make as many of such marks as are equal to one quarter of the whole number required. The object of showing a less quantity in Fig. 205 is to keep the illustration distinct and clear. Then we start from the point, K, and mark off the same number of points, represented by the lines, H, I, and ending at M; the center between the lines, G and M, at their nearest point of contact, is the true position of point No. 3, the point, A, being No. 1, and K, No. 2 By proceeding in a similar manner on the other half of the



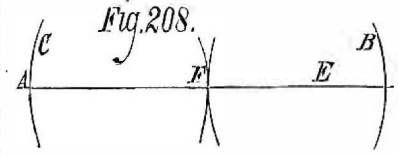
circle, we get the true position of point No. 4. If, in obtaining points 3 and 4, the compasses are not found to be set dead true, the necessary adjustment must be made; and it will be seen that, so far, we have obtained four true positions, and the process of obtaining each of them has served as a justification of the distance of the compass points. From these four points, we may proceed in like manner to mark off the holes or points between them; and the whole will be as true as it is practicable to mark them off upon that size of circle. In cases, however, where mathematical precision is required upon flat and not circumferential surfaces, the marking off may be performed upon a circle of larger diameter, as shown in Fig. 206. If it is required to mark off the



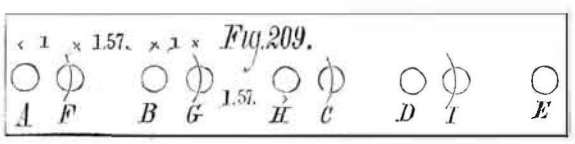
circle, A, Fig. 206, into any even number of equidistant points, and if, in consequence of the closeness together of the points, it becomes difficult to mark them (as described) with the compasses, we mark a circle, B B, of larger diameter, and perform our marking upon it, carrying the marks across the smaller circle with a straight edge placed to intersect the centers of the circles and the points marked on each side of the diameter. Thus, in Fig. 206, the lines 1 and 2 on the smaller circle would be obtained from a line struck through 1 and 4 on the outer circle; and supposing the larger circle to be three times the size of the smaller, the deviation from truth in the latter will only be $\frac{1}{3}$ of whatever it is in the former. If the number of points to be marked off on any circle is an odd one, the only variation from the above instructions is as follows: Suppose that we have commenced at the point marked 1, in Fig. 207: we mark off half the re-



quired number of holes on one side and arrive at the point 2; and then, commencing at the point 1 again, we mark off the other half of the required number of holes, arriving at the point 3. We then apply our compasses to the distance between the points 2 and 3; and if that distance is not exactly the same to which the compasses are set, we make the necessary adjustment, and try again and again until correct adjustment is secured. It is highly necessary, in this case, to make the lines drawn at each trial all on the same side of the circle and of equal length. For example, let the lines, A, B, C, D, in Fig. 207, represent those made on the first trial, and E, F, G, and H, those made on the second trial; and when the adjustment is complete, let the last trial be made upon the outside or other side of the circle, as shown by the lines, I, J, K, L. Having obtained the three true points, marked 1, 2, and 3, we proceed to mark the intermediate holes, as described for an even number of holes, save that there will be one more mark made on one side of holes 3 and 4 than there are on the other side of them. In cases where mathematical exactitude is not a requisite, and an odd number of holes is required, after setting the compass points as nearly true as necessary, and obtaining from them the points 2 and 3, we may take another pair of compasses, and find with them the center between points 2 and 3. Then taking the first and adjusted pair of compasses, we make a mark, as shown in Fig. 208. We first draw the line, E, and, resting one leg of the compasses on the point, A, we draw the segment of a circle, B; then resting the point of the compasses on the point of intersection of B and E, we draw the segment of a circle, C. The distance, at E, between the two segments, B and C, represents the required distance apart of the holes. We now take our extra pair of compasses, and find the center of B and C, as denoted by the point, F, setting the compasses to the exact center, so that, when one point rests on F, the other will come fair with the lines, B and C. We turn to our work represented on Fig. 207; and from the center found between points 2 and 3, we make, with our extra pair of compasses, a mark on each side of that center, which will represent the correct position of points 2 and 3; and we then correct the variation between them nearly enough for ordinary purposes without the tedious process of going over the whole ground again, because the distance between points 2 and 3 was not precisely correct.



In marking off any number of holes varying in their distances one from the other, the variation being regular, as for instance holes around a 30 inch circle, 60 in number but each two holes being 1 57 inches apart, the distance between the next two would require to be 1 inch, and so on, as shown in Fig. 209. The total number of holes must in this case be an even one; hence we mark off, by the rules already given, one half of that total number, making them equidistant all round the circle or circumference, as the case may be, which points will represent the distance apart of the holes that are widest apart, as the holes, A, B, C, D, and E, in Fig. 209,



amounting in our example to 30 in number. We then set our compasses to the required distance apart of the two holes nearest together; and commencing at A in Fig. 209, we mark the center for the hole, F, and from the center of the hole, B, the center of the hole, G, and so on, continuing all round the circle, but taking care to mark the new center in each case in advance of or behind the points, A, B, C, etc., according to the manner in which the first of the holes nearest together was marked. Thus in Fig. 209, the points, F, G, H, and I, are marked to the right, in each case, of the points from which they were struck.

There are of course many variations in the grouping of holes around a circle, but all the principles involved in marking them off are shown in the examples given above.