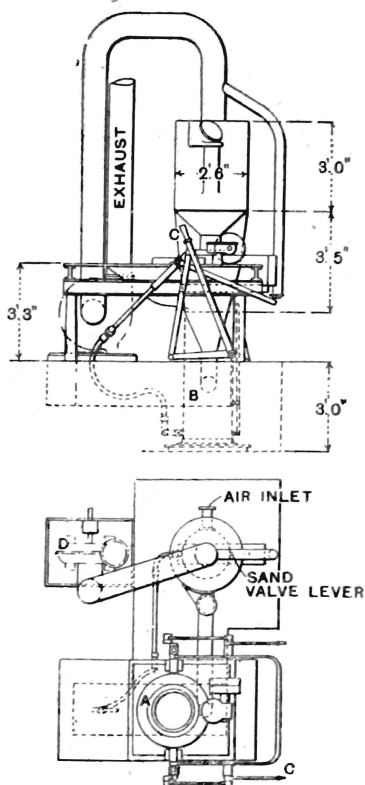


limit, for iron, steel, and copper alloys, also a diagram shewing how the hardness of the heat treated shell gradually reduces from the base to the nose. A further fixture is illustrated for testing the hardness of the brass cartridge cases, which will be referred to later.

In many works, perhaps those not so well equipped, drilling machines have been used for boring out solid blanks, instead of working on forgings, and, whereas this method of drilling is the better one for the high explosive shell, it is nevertheless being used in certain shops for shrapnel. For cleaning out the scale from the heat treated shell, a sand blast is mostly used, and Fig. 17



Arrangement of Shell Cleaning Machine.

Fig. 17.

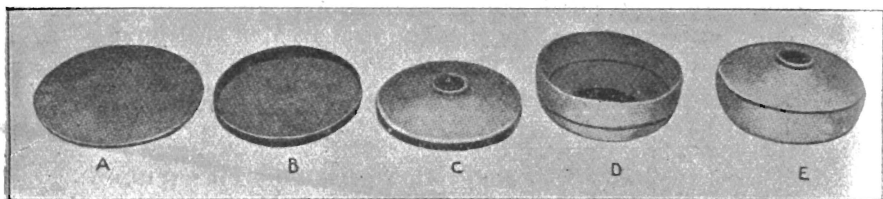


Fig. 18.

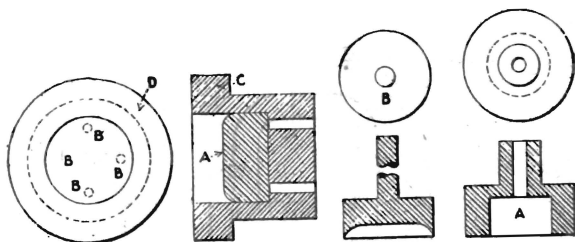


Fig. 2. Bottom Die used for Drawing the Powder Cup Bottom.

Fig. 3. Punch Used in Drawing Powder Cup Bottom

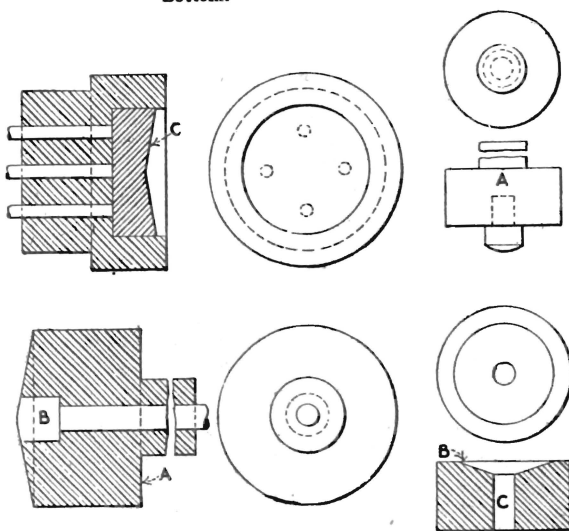


Fig. 4. Punch and Die for Powder Cup Top.

Fig. 5. Flanging Tools.

Fig. 19.

illustrates the arrangement of a blasting machine for this purpose; this is also used principally for cleaning out the recess for the wave band on high explosive shells, and for cleaning the bodies of all dirt or grease before varnishing.

Referring to the tin powder cup, or magazine, at the base of the shell, Fig. 18 illustrates the steps in the process of making one of these from a disc to the complete article. The sheet has to be heavily tinned, and of good drawing quality, the bottom of the cups .022 thick, and the top .036; to manufacture these powder cups should be a simple matter for the smallest of shops.

The steel disc which is placed over the powder cup is another article produced by stamping, and Fig. No. 19 shows the tools for making these, and samples of the discs themselves. The making of the balls, or bullets offers no difficulty, and Fig. 20 shows, in diagrammatic form, a 12 punch die for shearing the balls from lead wire.

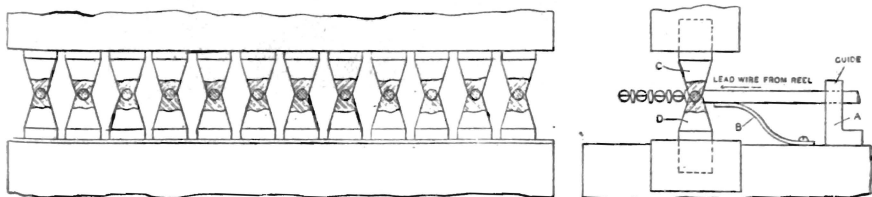


Diagram illustrating "Twelve-punch" Method of Making Shrapnel Bullets from Lead Wire.

Fig. 20

The bullets are $\frac{1}{2}$ in. in diameter, and composed of 87 per cent. tin, and 13 per cent. antimony. The punch illustrated, has a capacity of 850 per minute, but the bullets have afterwards to be put in a tumbler drum for removing the fins and burrs. Fig. 21 shows an alternative method of casting the bullets, the output of such a machine being approximately 100 per hour, but although the output is less, the bullets are better.

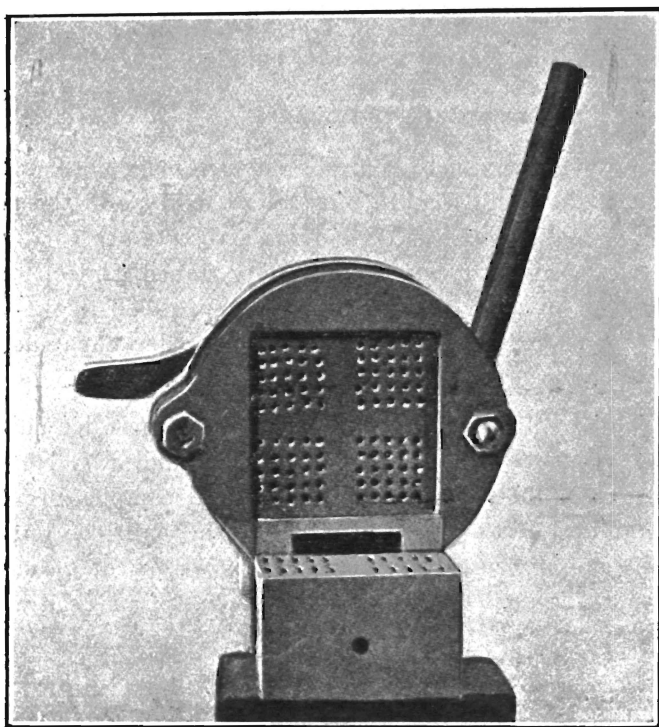


Fig. 21.

Now referring to the cartridge case; Fig. 22 shows the complete evolution of the cartridge case, from a brass disc about $6\frac{1}{4}$ in. diameter, by a little more than $\frac{3}{8}$ in. to $\frac{7}{16}$ in. thick, whilst Fig. 23 shows details of the plungers and dies for making the cartridge cases.

Although we are not accustomed to the drawing operations as required on a cartridge case of this kind here, it might increase our confidence when we know that the tools in question were made by a large locomotive shop in Canada. They were used on bulldozers and frog-

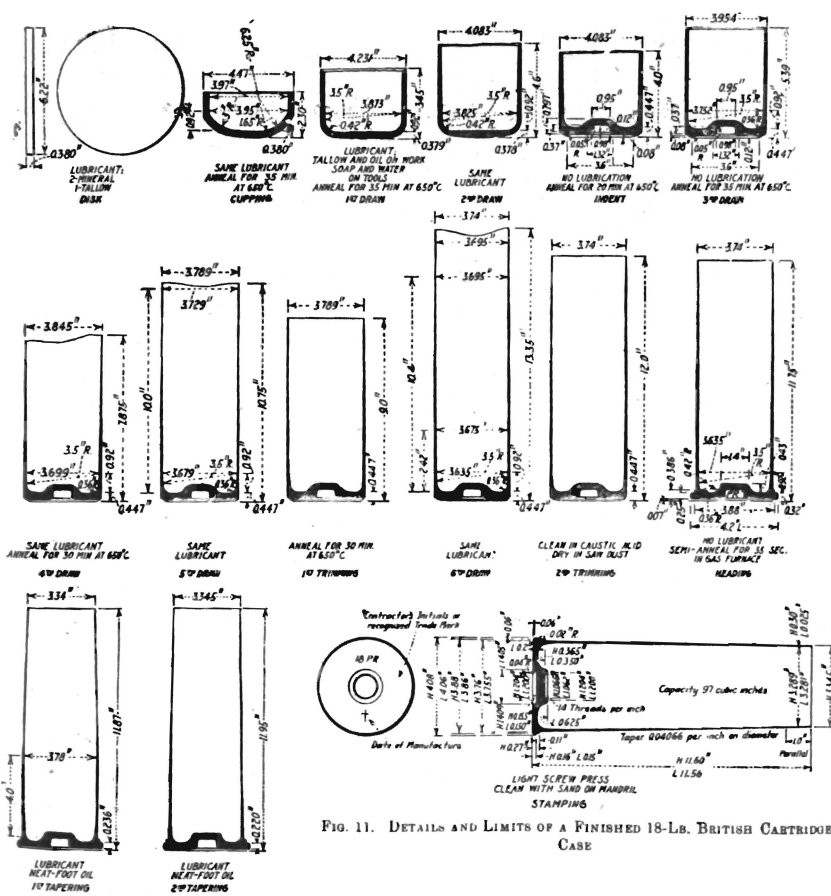


FIG. 6. VARIOUS STAGES OF THE CASE REPRODUCED FROM ACTUAL SECTIONS

FIG. 11. DETAILS AND LIMITS OF A FINISHED 18-LB. BRITISH CARTRIDGE CASE

Fig. 22.

planers, some of which were 20 years old, and the output is nearly 3000 per day, and, what is most striking, there is not one man employed on this work who had previously worked in a brass-drawing shop, or had had much experience of a similar nature.

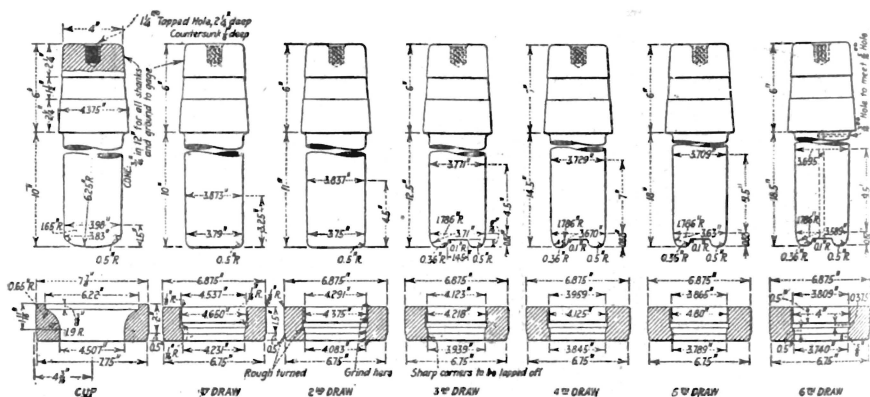


FIG. 9. DETAILS OF THE PLUNGERS AND DIES USED FOR MAKING 18-LB. BRITISH CARTRIDGE CASES

Fig. 23

I have referred fully to operations for the manufacture of shells, which do not require automatic machinery. Although I understand that the Government, and perhaps one or two private firms, propose to import machinery specially for the purpose of making shells, there is no doubt that it is mainly the ordinary workshop with ordinary tools which has been mainly responsible for the output so far, and it will also probably prove to be the case so far as we are concerned.

Automatic tools for the complete machining operations on a shell are, of course, manufactured, and although the output is remarkable, the cost of tools, their installation, and what is more important to us, the delay in procuring them, is almost a bar to their consideration. Whilst there are, as remarked, complete automatic machines, there are also many firms supplying tools of a semi-automatic nature, and it is interesting to note that one such British firm is prepared to guarantee an output of one completed machined shell per minute, with a set of 12 machines costing, in England, £6000 stg.

It is, perhaps, generally known that an ordinary shell leaves practically no trace of its trajectory, and, although the emission of smoke when a shell bursts may be, perhaps, satisfactory for isolated firing at an object, it would be at least difficult, if not impossible, to tell where the shell from one gun of a battery exploded. To overcome this difficulty, what are called "Day-tracer" shells are used, and Fig. 24 shows one of these being drilled

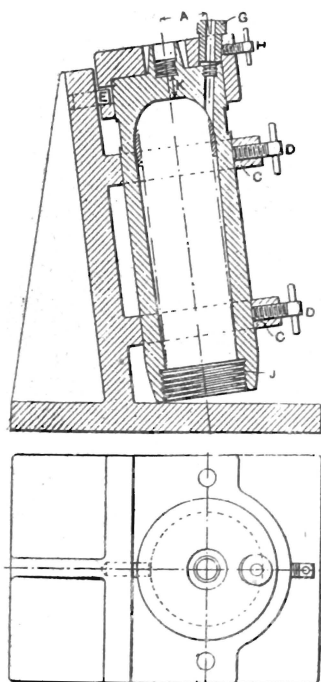


Fig. 3. Jig for Drilling Vent.

Fig. 24.

in a chuck to provide a vent in the base of the shell for the discharge of smoke-producing material, whilst a striking instance of the application of such a shell is shown on the next, Figure 25, upon which will be distinctly seen the smoke trail left by the day-tracer. This

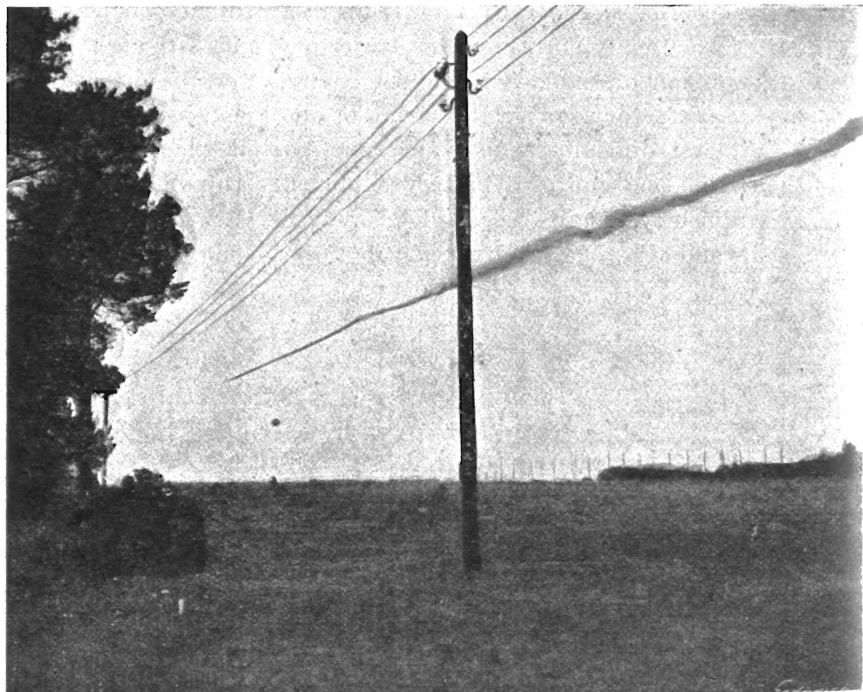


Fig. 25

shell was actually fired at a balloon which can be seen in the illustration. For such a purpose, it would be distinctly useful as providing a means for tracing the actual trajectory of the shell.

It has been suggested by some people that the day of the rifle is near its end, but it would be mere presumption for me to express an opinion. We do know, however, that the machine gun has played an important part in many operations of this war, and there would appear to be very little reason why machine guns should not be made in this country in our small arms factories, and it is quite conceivable that if the Commonwealth factory had been fully occupied from the beginning of the war, it might easily have turned its attention to the manufac-

ture of machine guns. A typical illustration of an English machine gun is shewn on Fig. 26, which shews the Vickers' gun, ready for firing, and arranged for wheeling. The capacity of such a gun is supposed to be equal to 50 single rifles, so that, assuming that each man with an ordinary rifle could carry 400 rounds per day, it would mean that the total daily capacity of a machine-gun is no

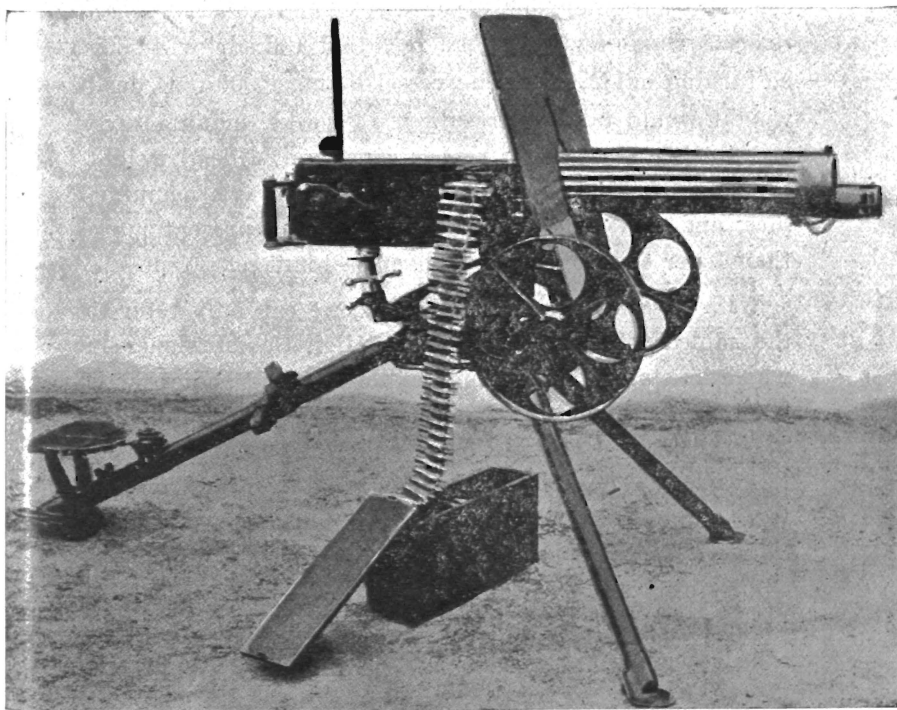


Fig. 26

less than 20,000 rounds, and, whereas, this force might be of tremendous benefit in certain phases of war, it is obvious that there is room for tremendous wastage if badly managed.

It has been stated that our geographical position renders the transportation of shells prohibitive, but surely this is not only incorrect but a poor obstacle to suggest to meet

a national need. Even assuming that the freight from here to Great Britain is 50/- per ton, this means that our shells would cost us 6d. each extra on this account; again it has been suggested that the transport of shells would interfere with the already scarce freight space.

If we in Australia were in the happy position of being able to help the Mother Country to the extent of 100,000 complete shrapnel shells per week, and this is worth remembering in view of the fact that Canada will soon be turning out 250,000, one vessel lifting 9,000 tons dead weight would take the result of 13 weeks' manufacture, or, in other words, four vessels capable of a dead weight capacity of 36,000 tons, would carry a year's manufacture, and this would not, I understand, represent more than 1 per cent. of our total oversea tonnage.

With regard to the cost of shells, we can only refer to the cabled information from our High Commissioner in which he stated that for high explosive shell bodies made from steel costing £15 per ton, and copper at 11d. per lb., 22/- each would be paid for the first 20,000 and £1 each thereafter. There is a shell body of this kind on the table, and those who have not already gone into the question can perhaps form an impression as to the possibility of our being able to keep within this price, which I am convinced we can do. Although we may not be asked to manufacture complete shrapnel shells and cartridges, it may be of interest to state that a complete shrapnel shell ready for insertion in a gun on a field in Flanders has been stated to cost approximately £3/12/-.

Before concluding, I would like to add that if we are to manufacture munitions here in Australia, we must act, and act quickly. We must organise, co-operate, and freely exchange ideas one with another, workshop with workshop, and State with State, with one object in view, and that to increase by every means in our power the rate of

production. Loss of time by us at home probably means the greatest sacrifice of all to those in the field who are bearing by far the greatest burden for the Empire, loss of life. We want to have enthusiasm but with order and determination.

The factor which seems to be deterring many here from taking up this matter very keenly is that they consider special tools and equipment practically essential to the manufacture of shells. Surely we have evidence enough to the contrary, and to those who have succeeded in this business, the cry has been "Do it with what you have got, but do it now." If we fail, each and every one of us to put all our strength and resources into the business, and we can only do so if the right spirit inspires our efforts, we will be culpable to the extent of standing by and not helping, or endeavouring to help to the best of our capacity, to shorten this terrible conflict. We have an active Munitions Committee in our midst, and to them we will look for the order to advance. Let us hope that they will be given the lead, even though late in the day, from the source we have most right to expect it.

If there still remains a doubt in anyone's mind as to the capacity of our shops to do useful work, I would refer them to the following remarks:—

The London "Times" states that over 200 shops in Canada are now employed in the manufacture of munitions.

The Manchester "Guardian" states that within a short time every large work-shop in India will be making munitions.

The London "Times" states that a remarkable machine-gun campaign is being conducted in Canada, in all, a thousand guns have been promised in a fortnight.

The London "Engineering Times" says: "Regular shell lathes are cast in the shade when their output is compared with the enormous amount of shell work that is being produced on turret lathes of all kinds and on common lathes with, or without, square turrets.

"There is no shop which is fairly and decently equipped with ordinary standard tools which cannot under technical guidance render valuable help in the making of munitions.

"The munitions of War, of which the nation stands in pressing need, are readily adaptable to distribution among all firms, large or small, almost irrespective of the machine tool equipment."

In view of the above, can anyone believe that the Engineering establishments of Australia are not sufficiently equipped to make small shells and other munition parts?

Can anyone doubt that we are in danger of our very existence as a nation?

With the means at our disposal, and with the example before us of what others are doing, how much longer will it be before we make a practical move and take our place alongside the other Dominions in the manufacture of shells and other munitions?

Before leaving the matter to others better able to discuss it, I would like to thank Mr. Clayton and our Honorary Secretary for their active co-operation with me in this matter, and we can only hope that our efforts may at least help to bring about in some measure the result that we all, I feel sure, desire, but which, unfortunately, so far, has not received the attention it deserves.