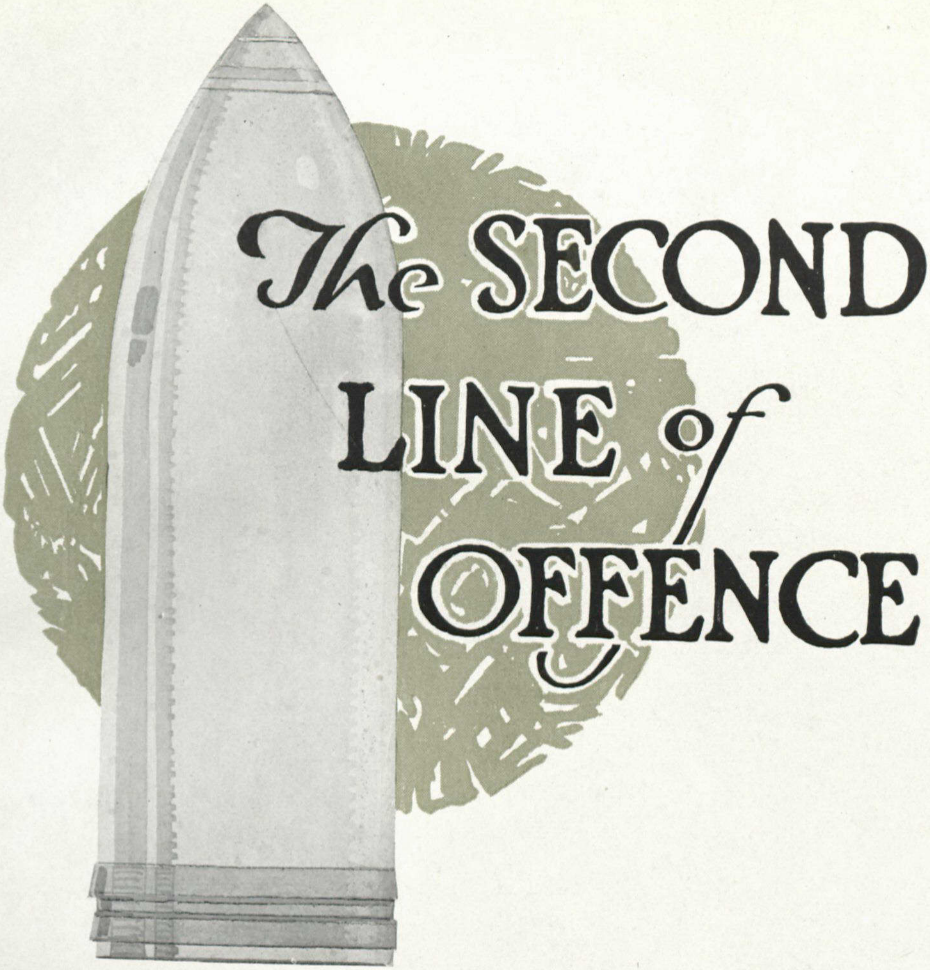
A GREAT ACHIEVEMENT

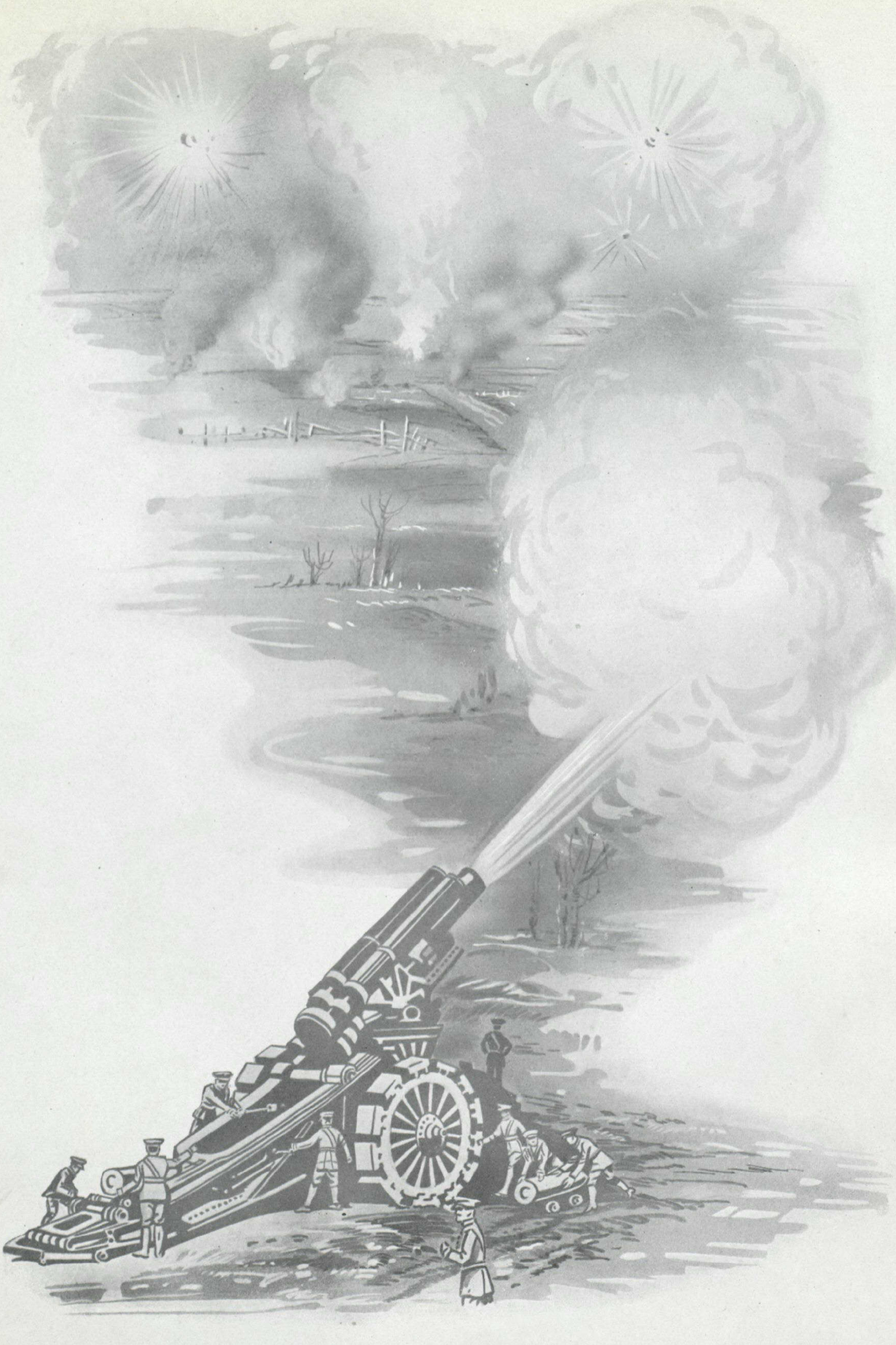
Compliments of

RUSSELL
MOTOR CAR
COMPANY LIMITED

Can. The Russell Motor Car Co. 2nd Cop

The SECOND LINE of OFFENCE





FOREWORD

"The Second Line of Offence," as it has been truly called, is the long line of untiring machinery running twenty-four hours daily and its crews of workers who have so ably and so abundantly supplied the men of Canada and their allies with the materials that bring victory.

The Russell Motor Car Company feels that an expression of thanks is due the men and women of its Second Line of Offence, those whose efforts made possible what was said to be an impossible task; and to them this book is dedicated—a recognition and a record of loyal and faithful service in the performance of which all were doing their bit with our brave boys in the trenches.

Lloyd Harris

President.

Toronto, December 31st, 1917.

OFFICERS OF THE COMPANY

—1917—

Lloyd Harris
President

C. R. Burt
Assistant General Manager

H. D. Scully
Secretary

J. A. Russell
1st Vice President & General Manager

The SECOND LINE of OFFENCE

BY SHAW NEWTON

MACAULAY, in his essay on Frederic the Great, speaks proudly of the wealth of England; the nation which his generation has seen raise the miraculous sum of £130,000,000 in a single year. That was just seventy-five years ago. To-day the mention of £130,000,000 jingles in the ears of even the most ordinary of mortals, like the ring of so much pocket money. England is spending more every month and has been doing so for many months. War has so accustomed us to think in terms of sheer bigness; in budgets of billions, in armies larger than whole nations of the older days, in battles that make the affrays of Napoleon read like a skirmish or a trench raid; that only the stupendous is apt to count any more. And yet, the part that the small things play counts more than ever before.

If it strikes you as ridiculous to say that victory rests upon 1/1000th of an inch, remain tolerant of the foolish remark until you have had time and the opportunity to consider the fuze.

So big is its job and so important, that the fuze seems a mechanism altogether too delicate, and Swiss-watch-like. Without the fuze the hugest shell would drop into enemy works with no more effect than an equal weight of stone or concrete. Without the fuze there could be no shrapnel, no high explosive shell, no torpedo, no mine; in fact, the warfare that we know now could not go on at all.

And in exactly the proportion that it is important, the fuze is delicate. The first function of the fuze is to explode the charge in the shell. The second (and this is just as important, if not more so than the first) is not to explode it except precisely when, and precisely where, the explosion should occur. The tiny jet of flame must be carried from the detonator to the charge with an accuracy measured in fractions of a second, and with absolute dependability; for the success of the calculation of a whole campaign may rest upon its doing its work. And doing its work means that a tiny ferrule of annealed bronze must resist a pressure of so many pounds—and no more; that a diminutive brass rod must move at the impulse of a calculated centrifugal force and not sooner; that the resistance and flexibility of a delicate coil spring be true to mathematical exactness. Upon such LITTLE things depends the burst of the shell and SUCCESS IN THE GREATEST WAR THAT THE WORLD HAS EVER KNOWN.

As you enter Plant No. 3, which is one of the factories where the RUSSELL MOTOR CAR COMPANY is working twenty-four hours a day at fuze-making, your first impression will be one of utter, bewildering confusion. And your second will be that a huge roomful of snarling, irritable automatics can sing a Hymn of Hate of incredible venom and vigor. The third thing that will occur to you is that the only person at all who is confused, or bewildered, is yourself. No one has noticed your coming. No one is showing the least curiosity about your inspection tour. No one will note your going about. No one, except you, hears the Hymn of Hate. Everyone else is too busy making fuzes; and making fuzes, even with automatic machinery that possesses human intelligence to a degree that is uncanny, is not the kind of work which allows much speculation as to the identity of the casual visitor.

For a while you are as one come suddenly out of a dark room into a blinding light. Then what was mere mass begins to take on form, noises to have meaning; and the whole resolves itself finally into Work. And this is work of a kind that you will rarely see. For it is work with no waste motions here, and work with no lost minutes. The big automatic machines are chewing up steel rods four at a time, and never stop. Just ahead are the single spindle automatics, the turret-lathes, the drills, the thread-millers—not waiting—but working; each one, in its proper turn, doing its bit in fashioning the chunk of metal that the machine behind has turned out. And there are no gaps of minutes, or even of seconds, when the machine ahead is waiting, and there is never a time when the machine behind is piling up work on the one next in line. It is a sight to delight the eye of a factory man. The huge, square building is crowded from end to end with serried rows of busy machinery and hundreds of busy girls; and the whole work progressing with a harmony of action that only the highest efficiency and the finest *esprit de corps* can produce.

This is Plant No. 3. It is turning out 600,000 fuzes a month. One of the Managers told me that it would be no difficult matter to increase the production by 100,000 per month if he were called on to do it.

However exceptional the degree of efficiency and team work you have just witnessed, and which you will see duplicated at the Purman building and in the Duncan Street building and in the Shell Plant, you can get no adequate idea of what has been accomplished unless you know a little of the history of the fuze industry in Canada.

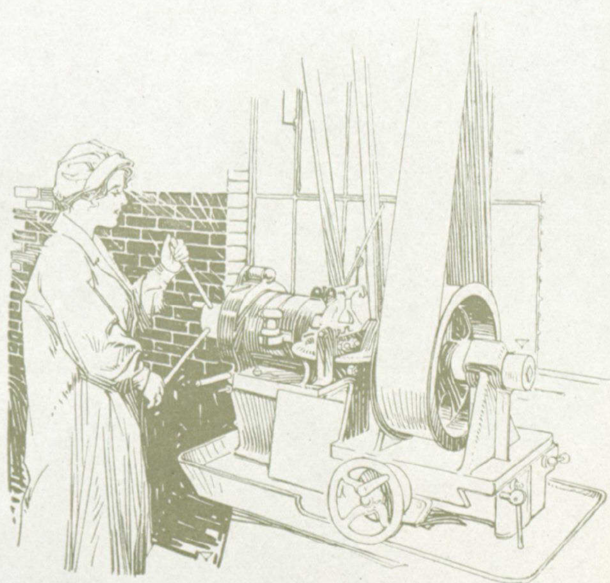
September, 1916, is hardly a year gone by. To-day you watch women and men turn out every twenty-four hours enough fuzes to send ten million pounds of shells with their message to the Hun. Here, September, 1916, was nothing more than a stretch of open field.

In addition to the lack of factories, machines and a force to run them—things considered essential to the success of well-regulated munitions manufacture—not a soul connected with the Company two short years ago had ever seen a fuze. And as big an obstacle as it may seem, and as in fact it was, the factory, in comparison with the other things that had to be found before the company could begin to fulfill its contract obligation, presented, all in all, the fewest difficulties. It was easier to get a factory than it was to get help. And it was easier to get help than it was to get machinery or material.

Industrial conditions in Toronto the year following the war were such that a suitable building was located without exceptional difficulty. The real problem was the obtaining of the needed equipment of machinery, tools, supplies and materials; and recruiting and training a working force with the ability and the will to develop a high productive capacity in the face of unusual quality restrictions and in an exceedingly short time. Time was as precious as—not gold, for Canada had promised things more precious than that—but as precious as steel, brass, shrapnel and finished fuzes.

The management found its problems were not confined to the four walls of a building, nor to the city, nor to the province. It must go to all Canada and to all the United States for the countless things needed, and get them in the teeth of the fiercest scramble for supplies that has ever been known. Every machine shop was overflowing with a flood of orders. Orders were taken with no guarantee whatever. Machines and machine tools could be ordered with the utmost confidence that they would not be delivered within months of the time specified. Castings, forgings, steel and brass were obtainable by hardly any means short of force.

Ordering what one wanted and letting it go at that was a hopeless procedure—little short of industrial suicide. Supplies were to the swift, machines to the tenacious. What the Company wanted it had to go and get, and that is exactly what it did. Within a week after the needs of the situation had been determined its representatives were in industrial centres all over the United States watching the Russell order. Nothing was allowed to interfere with its progress. Nothing was allowed to stand in the way of its shipment. If a rail congestion threatened and a shipment seemed likely to be held up, the Company's representative rode to Canada in the same car with the shipment and stayed there until it landed in Toronto. If the car was headed for a layover on some out-of-the-way siding—and it often was—it was his business to get it off the siding and on its way again. The means these men employed to keep their shipments moving when no one else got their stuff on time, or expected to, I do not know. To date no one has asked them and they have volunteered no information at all. I do know, however, that they did what they were sent to do. And I do know, too, that 90,000 pounds of brass and tons of automatics were rushed into Toronto by express. And I do know that in a remarkably short time—less than 90 days, to be exact—the factory was ready; fully equipped with machinery, well stocked with the precious tools and material; and what is more, there was a



working force waiting to man the lathes and the drills; a force well organized, well directed, and already gone through what training could be given in so short a time.

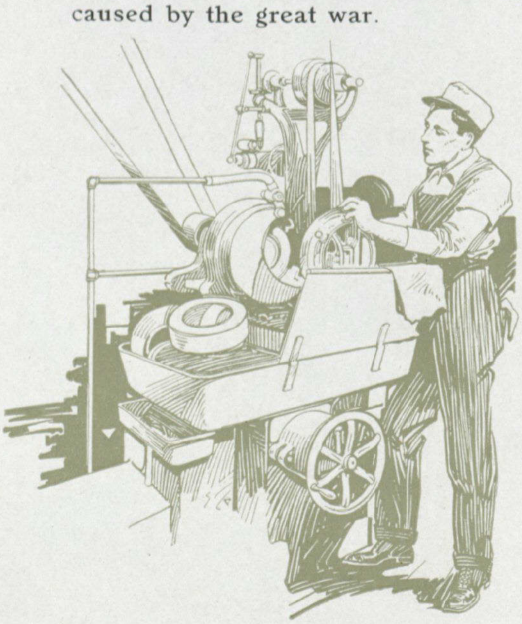
Incidentally the workers who were waiting to do the "manning" were not men but, for the most part, women. Women munitions workers, the first that Canada had seen; a departure from the paths of precedent by the Russell Motor Car Company that was shortly to be followed throughout the Dominion.

The employment of women war workers in the great munitions plants of England was not a new or untried measure. Years before the war economic conditions had forced the transfer of female labour from the mill to the factory. Women, from generations of familiarity with factory methods, had accustomed themselves to its conditions and requirements. War saw nothing more than expansion, on a large scale, of a system already in practice. In Canada the situation was altogether a different one. There were comparatively few women workers and what there were, were employed for the most part in the offices and the shops.

But Canada, sparsely populated from the first, had sent hundreds of thousands of her young men—her workers—to the fields of France. Toronto had sent more than any other city in the Dominion. The disruption of the social fabric was widespread and presented a problem of formidable proportions for which there was but one solution—female labour.

Naturally there were those who had misgivings. Women, they argued, have neither the strength to run the machine nor the generations of precedent behind them to accustom them to the rigid discipline of factory routine. Women are used to coming and going as they please; household work, and even office work, have none of the rigid elements of factory labour. Woman labour would fail.

As far as they went these sceptics were right. They had simply overlooked two very fundamental facts. One of these was woman's innate capacity and adaptability. The other the quiet determination that had sprung up within her, from a realization that she could do her part in alleviating and shortening the sufferings caused by the great war.



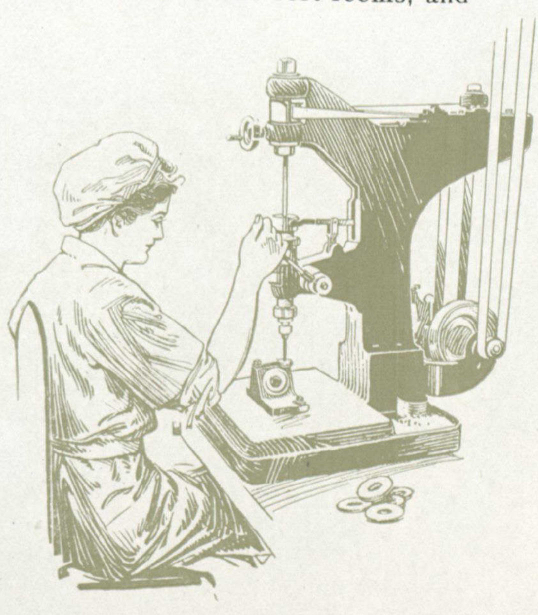
To-day, with nearly 4,000 women workers on the pay-roll, there is no one in the Company's organization who is a whit less than an enthusiast when he tells you what women workers can do. A mechanic is not apt to over-praise. The nature of his training and his practical mind tend to make him conservative, especially when he is a master of his craft, and more particularly when it is very easy to detect slipping off his tongue a definite Scotch burr or the broad "a" of England, as he tells you startling statistics in support of his argument that women in some departments can produce anywhere from ten to one hundred per cent. more than the men who used to work on machines.

There are instances where production has been doubled and more than doubled. And in nearly all cases, where the character of the work was not incompatible with her strength, the woman has done as well, where she has not done better, than the man she replaced.

Woman runs a lathe the way she knits a sock. She develops to an almost unbelievable degree a complete co-ordination of muscle, vision and machine. Her entire task becomes an habitual reaction. She works without realizing it. She undergoes a minimum of mental strain, and to the extent that she works with it she becomes, in effect, as mechanical as the machine itself—and a part of it. This faculty is the secret of woman's success in repetition work, and certainly this success cannot be questioned.

What difficulty there was came not from the woman's inability to run machines, but in adjusting herself to an entirely new order of environment and regularity of service. From pounding a typewriter in a downtown office is a far and hard jump to punching a time clock—especially if you are on the early morning shift. And if all you have ever done before has been to make the bed and keep your room in order and maybe help with dishes—or if you had been called upon to do nothing more strenuous than drive your own car, or a golf ball, and then all of a sudden had found yourself a mere unit in a big factory system, expected to obey rules and regulations and held accountable for not your hours, but your minutes, you could begin to appreciate the degree of determination, control and will to be of service that actuated the women who came, and who stayed on, doing their bit as grimly and as uncomplainingly as the men across the water.

On January 1, 1916, when operations commenced the Company had an organization—not perfect, nor anywhere near it, but an organization that knew its work and did its work with a harmony and a persistence that in a few months placed production so far ahead of the monthly contract schedule that the Company was able to show a decided reduction on former prices on each new contract. At the same time the workers were enjoying a wage of most unusual proportion. And each day sees added to the factories improvements in hospital facilities, lunch and rest rooms, and other welfare measures, which impress one as being almost lavish in view of the temporary character of munitions manufacturing.



The success of the first venture into a new realm of manufacture with a new type of worker had hardly had time to make itself apparent, before the award of a contract for the manufacture of 2,500,000 fuzes of a new type brought the Company face to face with a new and greater task than had confronted them the year before. In September, 1916—when this contract for No. 101 fuzes was awarded—Toronto was a different city. In 1915 the securing of a factory was a minor obstacle. In 1916 it was well nigh impossible—and to this situation was added the fact that tools and materials could only be gotten by the same strenuous efforts as before, and that labour was scarcer than ever.

Naturally the experience of 1915 had pretty well determined the method of going about ordering machinery, tools and raw material—and making sure their delivery—and this method was followed throughout with results equally good. The plant was the problem. The time allowance stipulated in the contract indicated that approximately 3,000 hands would be required to fulfill the obligation, and in all Toronto there was no building available which was anywhere near adequate to house that many. A plant would have to be built—and there was at the very outside three months in which to do it all—plan, layout, erect, equip and put into working order.

The work commenced September 15. On that day the piers for a building 300 by 290 were sent into the ground.

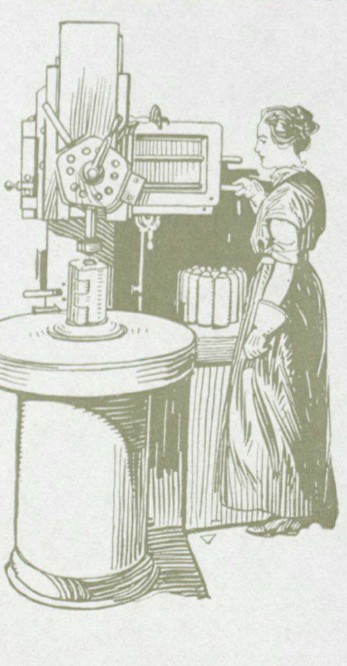
Forty-two days later the overhead gear was complete and in place.

One hundred and two days later—on December 12—power was connected and the machinery started.

In the month of December 14,000 fuzes were turned out and accepted.

The following April 350,000 were manufactured, in June 650,000 graze fuzes and 350,000 time fuzes, totalling 1,000,000 for the month. To-day the capacity can be maintained at a million, but production is so far ahead of schedule that it is doubtful that this amount will ever be called for.

In this No. 3 plant, every single day, 125,000 pounds of steel bars are fed into the jaws of ravenous automata; and every second beat of your pulse a finished fuze passes the critical scrutiny of the inspectors. Here as you listen to the crunch of the lathes, the whine of the drills, and see hundreds of feet of shafting over your head, and miles of belting whirring and humming around you, and the marvel of whirlwind production in the midst of a seeming whirlwind of confusion, you find it hard to believe that not a year ago this was open sky and open field.



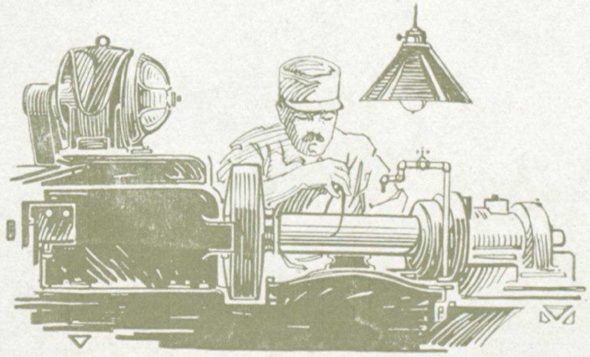
The achievement of the Company's organization cannot be accredited to any one individual or group of individuals. It is not the work of a department, or of departments. The people who did the work are people such as you see and I see on the streets of every Dominion city. They are, for the most part, Canadians. Amongst them are English, Scotch and Americans. There are men whose lives and whose skill have been devoted to the lathe. There are men who never saw the interior of a machine shop before the war. There are women drawn from all the walks of life; those who have always known what it is to earn their own ways and do their own thinking and live the economically independent lives that the civilization of the New World first made woman's privilege. And there are those who never before knew what soiling the hands meant.

These are working side by side, lathe to lathe. The minute they pass the gate and don their working clothes all differences in condition and all differences in purpose cease. When work commences there is an equality such as even America never saw before. These girls are earning a wage that few men ever earned before the war. Twenty, thirty, and even forty dollars in the weekly pay envelopes are so frequent as to elicit no surprise. In spite of this no one yet has hinted that high wages was the answer to the question, and no one who has ever seen these fuze workers on the job would.

Two very significant things will obtrude themselves upon the attentive person—the number of married women, most of them young women, whose names you will see on the time card rack; and the proportion of those who, as the shifts change, come and go in mourning.

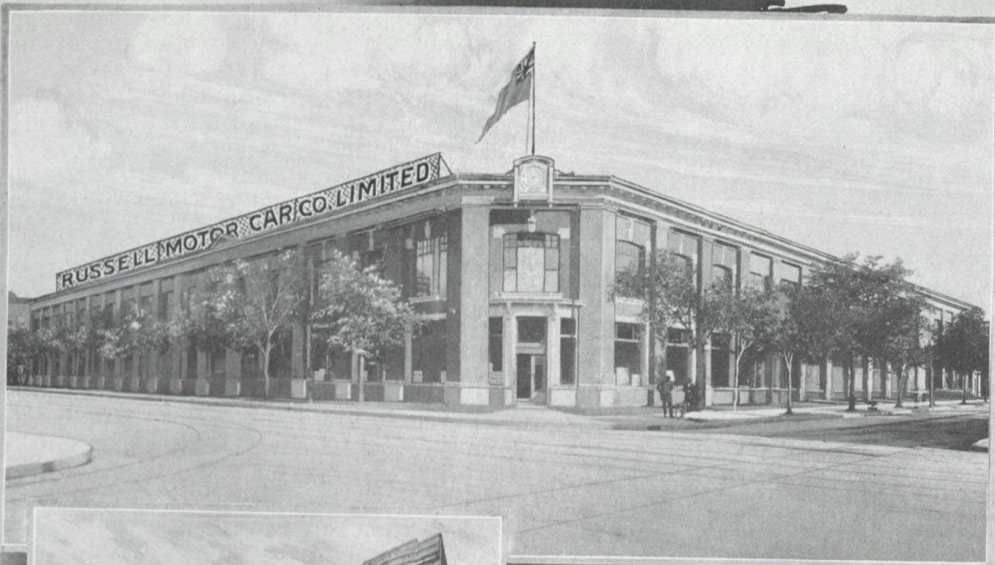
I was talking to one of the girls in the factory about this one afternoon just following the late July offensive in Flanders. "They've just taken Sanctuary Wood," she said; "you remember the fighting there two years ago. They had used up their ammunition allowance and the Germans drove them out. My brother was killed in that fight. But there's plenty of ammunition now, and I am helping to make it."

There you have the secret in a sentence. A fuze, if it is properly made, may be the means of killing anywhere from one to one hundred Germans. The fuze that fails to work, and the fuze that does not get there, may mean, on the other hand, the deaths of as many gallant Canadians, and amongst those Canadians are brothers, fathers, sweethearts, friends. The girl who does not do her bit and do it a little better, and a little harder than she can, knows down in her heart that she is potentially a murderer.



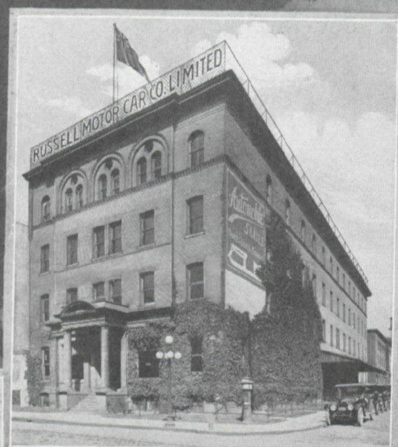
This Booklet describes the Company's activities during the period of maximum production up to November, 1917. Since that time there have been important changes in the organization and in the character of the output, which we hope to tell of in our next edition.

TORONTO FACTORIES OF RUSSELL MOTOR CAR CO. LIMITED



FACTORY NUMBER TWO

FACTORY NUMBER FOUR



FACTORY NUMBER ONE

FACTORY NUMBER THREE

NUMBER EIGHTY

TIME AND PERCUSSION FUZE

Manufacture of No. 80 TIME and PERCUSSION FUZE

THE No. 80 fuze is of the type that can be set to explode the shell at any second of time determined upon (up to twenty-two seconds after leaving the gun), the timing apparatus being accurate to tenths of a second. The method of operation of the firing elements of the fuze is as follows. A stirrup spring holds the time pellet, containing the time detonator, away from the needle, preventing ignition. The time pellet gains enough impetus from the firing of the gun to collapse the stirrup spring and impinge the time detonator on the firing needle. Detonation results, igniting the powder train in the top ring. This in turn ignites the train in the bottom ring and from there the flash is carried into the shell and the explosion follows.

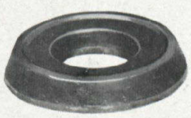
The time of explosion is regulated by setting the moveable bottom ring, according to the time graduations on the fuze.

In addition to the time element there is present also a percussion element. This ignites the powder in case the shell strikes an object before the timing element functions, or in case the timing element for any reason fails to work properly.

The percussion pellet, containing the percussion detonator, is located in the base end of the fuze and functions directly, the detonator being thrown against the needle by the impact of the shell and the flash is communicated immediately to the explosive charge of the shell. The exact working of the percussion pellet is more completely described on page 28.

The body and cap are made from brass forgings. The rings and base plugs are cut from brass rods (as shown below).


BODY


BOTTOM RING


TOP RING

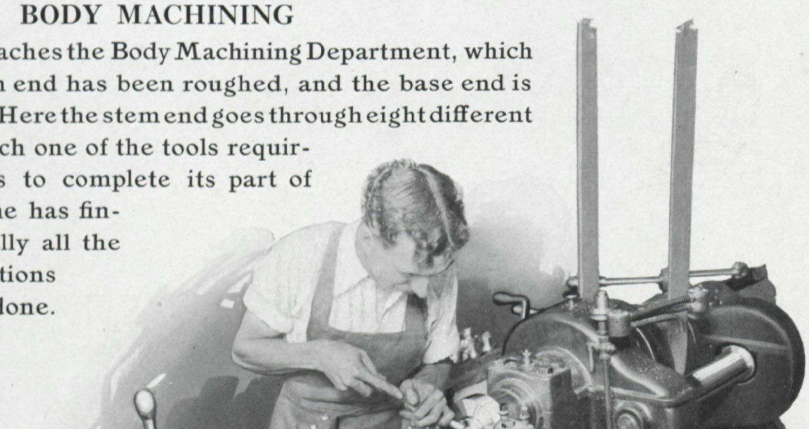

CAP

The operations in the manufacture of the body commence in the basement of the Purman Building, where a battery of turret lathes equipped with air-chucks—operated by men—"rough" the stem, or upper end. In this operation the cylindrical surface is machined down to about .020″ oversize, four machines turning out about 1,400 bodies per hour. The next operation finish turns the base end. The stem end, semi-finished, is held in a collet and a turret lathe machines the base end. The machining includes boring and counter-boring the pellet-hole, machining the seat angle, forming the magazine chamber, and turning the outside diameter of thread ready for thread milling. A subsequent operation rough forms the outside face, or cone angle, and the platform on which the bottom ring is to be seated.

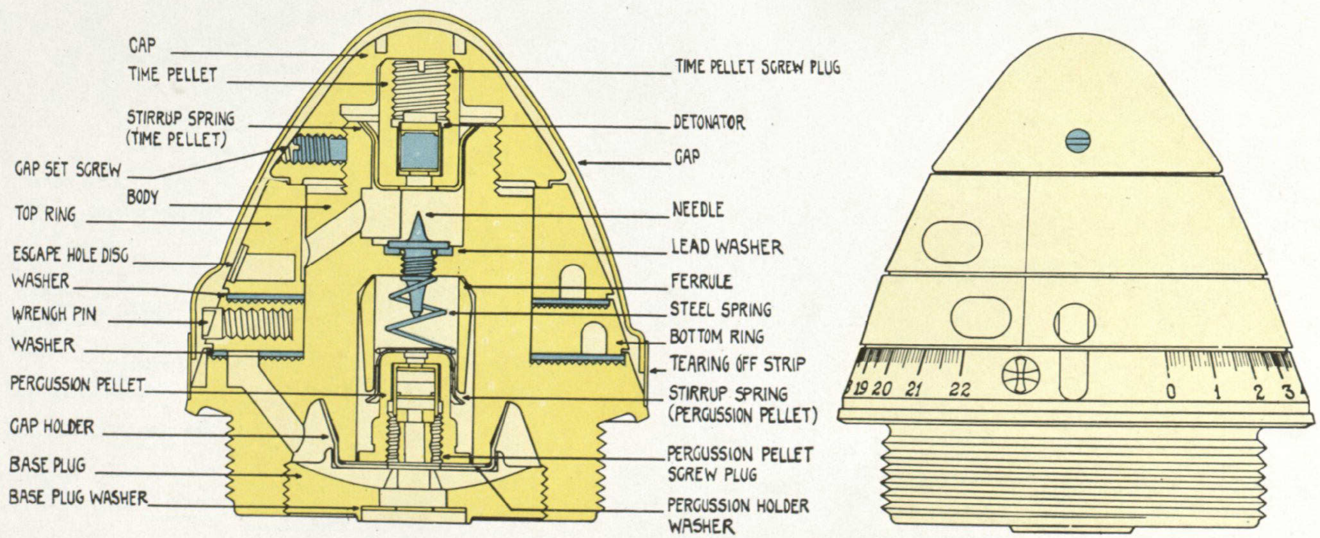
GENERAL VIEW OF BODY MACHINING DEPARTMENT

BODY MACHINING

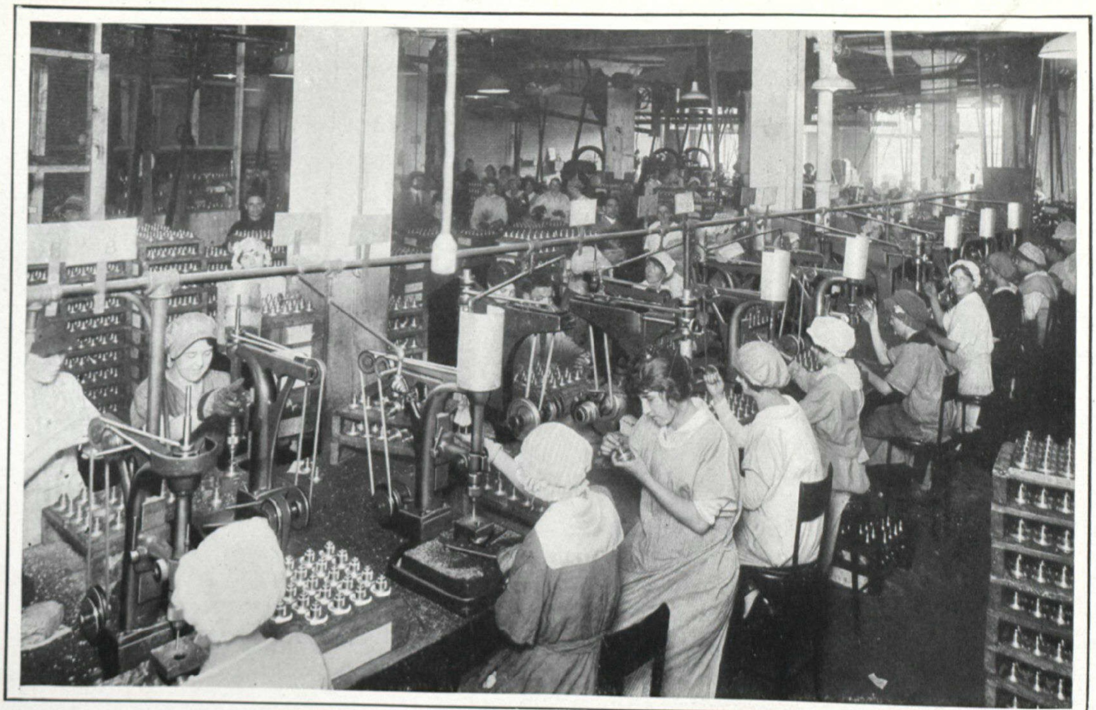
¶By the time the body reaches the Body Machining Department, which is shown above, the stem end has been roughed, and the base end is in fairly complete form. Here the stem end goes through eight different machining processes, each one of the tools requiring about eight seconds to complete its part of the job. After this lathe has finished its work, practically all the major machining operations on the body have been done. In the sixty seconds that the body is in this lathe the form for the cap thread is cut, the stem hole is rough drilled, reamed and sized, the stem turned, the serrations in the ring platform are cut, the groove on the outside surface into which the brass capsule or cover is soldered is formed, and various minor finishing operations are done.



MACHINING STEM END OF BODY



The BRITISH TIME AND PERCUSSION FUZE
No. 80



DRILLING OPERATIONS ON BODY

The complete department for machining the stem end of the body can turn out about 15,000 units a day, working two shifts. There are nineteen men on a shift and nineteen inspectors, one to each machine.

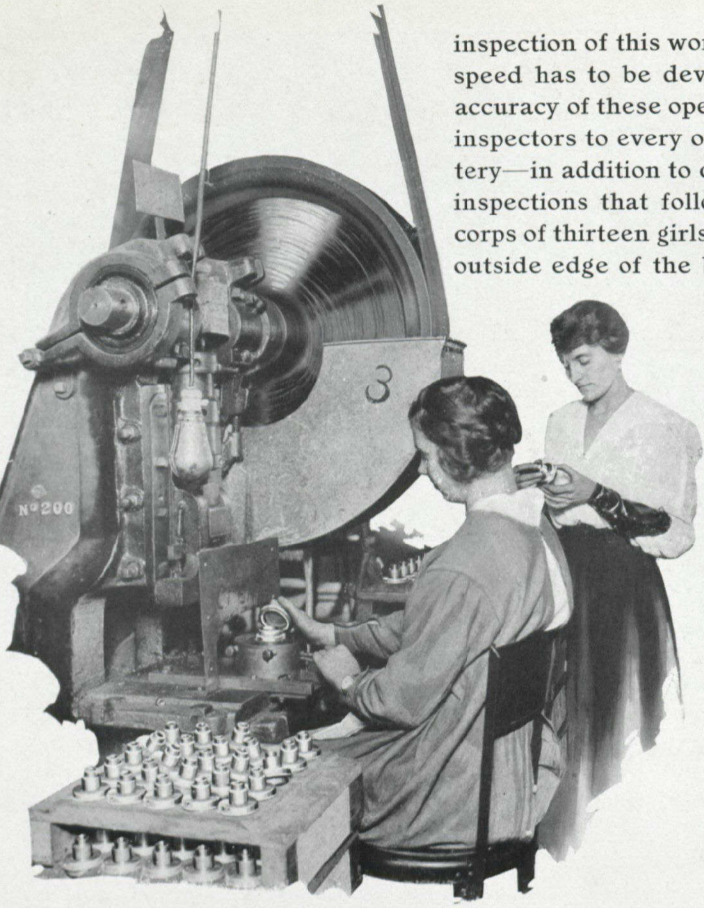
Before the drilling commences there are two threading operations which are not illustrated, cutting the thread on the stem for cap, and the thread in the base for the base plug, the work being done on machines capable of threading 3,000 bodies a day.

OPERATIONS ON THE BODY IN THE DRILLING DEPARTMENT

¶ In the drilling department there are between thirty-five and forty women in each shift, the machines stretching in a long row, back to back, from one end of the building to the other.

The work of this department is for the most part drilling the two flash holes, and the needle hole. The latter hole is also counter-bored and thread cut. In addition, the platform is reamed ready for the graduations which are stamped on it in a subsequent operation, and the keyslot and undercut are milled. Many of these operations seem of a minor nature when we think of the fuze as a whole, but every one of them contributes directly to the effectiveness of the finished product. Not only the highest degree of skill and accuracy is called for and insisted upon in the

TINNING FLANGE FOR COVER



inspection of this work, but an extraordinary rate of speed has to be developed and maintained. The accuracy of these operatives is assured by a corps of inspectors to every one or two machines in the battery—in addition to complete shop and government inspections that follow. Following the drilling, a corps of thirteen girls solder a thin shoulder of tin on outside edge of the body (illustration on page 17).

The purpose of the rim of tin is to maintain an absolutely water-tight surface after the brass cover is put in place. These thirteen, working with an electric soldering tool, can turn out on an average of 1,500 bodies a day each. There is one inspector to every two machines. After this operation we may consider that the manufacture of the body is practically finished. However, the illustrations on this page which show the stamping of the time graduations and the enamelling of the graduations and numbers, illustrate two very essential features of the finished fuze. On the perfect accuracy of relation between these graduations and the flash hole rests the precision of the timing of the explosion and consequent effectiveness of the artillerist's work. The first picture shows how the graduations are put on. A specially constructed die was designed (after very elaborate experiments) to perform this operation.

PUTTING TIME GRADUATIONS ON THE BODY

This die is moveable under the power press and provided with suitable guiding strips. The die is pulled toward the operator, the body placed on a locating pad in the die and the die pushed under the press to a locating stop. After the blow of the press is delivered the die is pulled toward the operator again and the body ejected by a throwout arrangement. This enables the operator to load and unload the die without the risk of putting her hand under the press.

ENAMELLING GRADUATIONS ON THE BODY

FINAL FACTORY INSPECTION OF BODIES

After the graduations are stamped the figures are rolled on by a hand press, the "safety cross" (the point at which the fuze is set while the shell is being handled) is put on, also by hand, and the body is carefully washed in gasoline before the enamelling is done. The present method of enamelling, which was worked out in the factory, is not only very much faster, but a very much pleasanter task than formerly. The body rests on a pivot and is rotated by the operator who enamels the entire surface of the rim. Then, after drying, the bodies are polished on a revolving head, and the surplus enamel taken off.

FINAL FACTORY INSPECTION OF BODIES

All the operations on the body have been inspected as they were completed with an accuracy almost unheard of in any other line of work. In fact, about one-fourth of the workers in the various departments are trained inspectors, and every body, before it comes for the final factory inspection, has been examined three or four times at the very least, and gauges "go" and "no go" have been used after every new step.

In the department where the final factory inspection is made there are employed about ninety people. These people have all had a special training under the head of this department and are employed in no other sort of work. They are trained to use three methods in examining a fuze body—methods also employed in inspecting other parts and shells. The first is the "visual"—and the eyes of these experts are so highly trained that imperfections amounting to a bare hundredth of an inch rarely escape their notice. Then by touch, too, they are able to feel the very slightest variation from the normal. Following this is the gauge method. Two gauges for every dimension are used, a "go" which is supposed to pass readily over the part measured, and a "no go" which must not pass. The percentage of "rejects" from government inspection after these people have completed their work is surprisingly small.

Processes in the Manufacture of Time Ring

THE two time rings used on the No. 80 fuze are made in the factory at King and Duncan Streets. As before stated, these rings are made from solid bars. In the first operation a bar is pushed through the lathe spindle and rough bored about eight or nine inches. The rings are then chamfered and cut off, a suitable allowance being made for the subsequent finishing operations. There are seven of these machines working day and night, four top rings, three on bottom, with a capacity of 270 bottom or 200 top rings per hour.

BORING AND CUTTING OFF TIME RINGS

¶ After the rough boring and cutting off, which is done by men, the rings are bored, reamed, and faced by women operators. A combination tool is used on this work—of late design—with which an operator can produce 3,000 rings in one shift of nine hours. This means that twelve operators working nine hours can accomplish what was formerly done by twenty-one operators in two eight-hour shifts. The facing of the bottom ring is done by a serrating tool similar to that employed on the platform of the body—to

BORING AND FACING TIME RINGS

VIEW OF DEPARTMENT FOR BORING AND FACING TIME RINGS

provide, in both cases, seating for a felt washer. You will find working on these lathes the first women operators in Canada. This is a process which is decidedly laborious, and requires strength as well as skill, and it furnished a notable example of the efficiency of women.

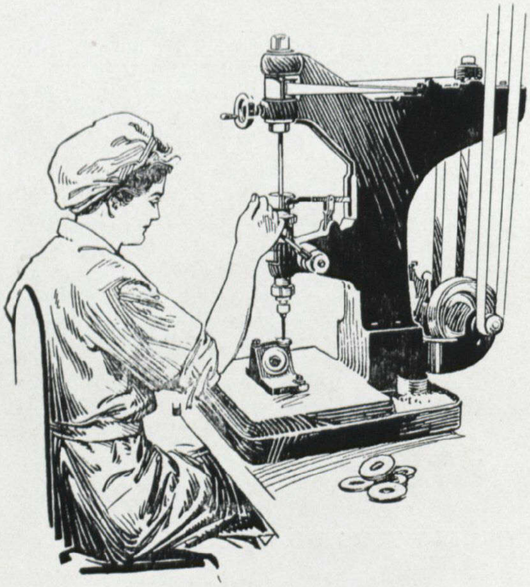
The first boring operation on the rings removes considerable of the surplus metal from the outside diameter. This turning finishes to exact size. The illustration below shows the operation which machines the profile of the rings—the part that forms the conical section of the fuze. There are twelve turret lathes on this work and the women are averaging about 1,500 a day with a high record of twenty-five hundred. The productive capacity of these machines has been greatly increased by a design originated in the Russell machine shops by which the time of putting the ring into the machine and of removing it was very materially shortened. This, by the way, is only one of the many contributions of the expert machinists in the Russell organization, which has done its share toward increasing production and decreasing costs.

The flash from detonation as it passes from the top to the bottom ring needs air for proper combustion. Hence there is provided an escape hole which is bored into the side of the bottom ring. As the flash reaches the escape hole it blows off the brass disc which covers it and thus exposure to the air is secured. In order that the brass escape hole disc fits tightly it is necessary to recess the escape hole. Five milling machines—such as are shown on page 22—with a daily

FINISHING TURNING OF TIME RINGS

MILLING ESCAPE HOLE

capacity of three thousand are used in milling the escape hole. The recessing is done later among the many minor operations that are necessary before the rings are in a finished condition. These minor operations, in addition to the recessing process, have to do mainly with assembling, milling and finishing the setting pin or wrench pin which is in the side of the bottom ring and is used in adjusting for time; milling the under-cut—a recess in the bore of the top ring, which serves as an air chamber; and burring off slight irregularities which are thrown up by the rapidly revolving tools. When I speak of these as minor operations I use the word "minor" as referring to size perhaps, and to time necessary for their completion. It has nothing to do with their importance. So far as *that* is concerned there are no minor operations in fuze manufacture. The "slight irregularity"—and slight it is, so slight that neither you nor I could detect it—can spoil all the work of the rest. It can mean that hundreds of dollars worth of time, labor and materials have gone for nothing—or worse, have failed where a failure can mean more to civilization and happiness than we can tell.

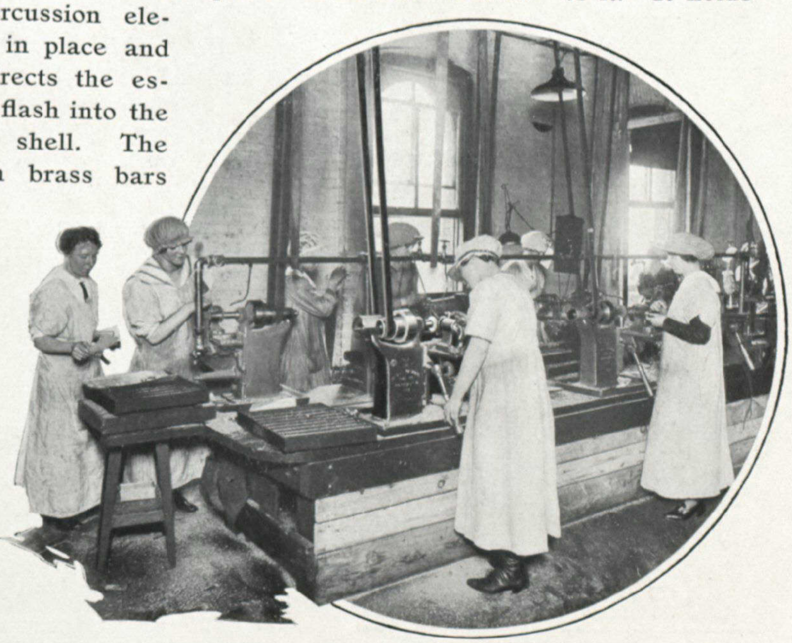


Manufacture of Base Plug

MACHINING BASE PLUGS

THE base plug screws into the base of the fuze; in ordinary language it would be spoken of as the "bottom" of it. It holds the percussion elements in place and also directs the escaping flash into the powder tube of the shell. The base plug is cut from brass bars in automatic lathes with four spindles. On these machines the inside face is finished and counterbored, and the thread and outside face are roughed. A small hole is bored in the centre which pilots the tools for the subsequent counterboring operations.

¶ The next operation is done on small turret lathes. For this



MILLING SLOT ON BASE PLUGS

operation the base plug is held by the counterbore on an expanding arbor. This counterbore is finished in the first operation, and holding by this means insures concentricity of the one face with the other. In this position the outside face is finished and the base plug is finish bored and counterbored for the washer.

There are five women working on this operation and each of their machines has a capacity of about 2,500 a day. The third and only other major operation on the base plug is the milling of the slots (shown on page 23). These slots meet over the base plug hole, forming a deep cross. Their purpose is to form channels for the flash as it passes into the shell—to form the last part of the course, uninterrupted except when the fuze is set at "safety" through which the tongue of flame, which is to sow destruction and scatter bullets on earth and man below, passes from the detonator to the powder tube. This milling is done with a four point indexing fixture and a $\frac{5}{32}''$ circular saw. Four machines are operated with an average capacity of 3,200 daily.

These processes finish the base plug manufacture with the exception of drilling the wrench holes in the bottom, boring, counterboring and tapping the filler screw hole, and finish sizing the thread.

PACKING BODIES FOR SHIPMENT TO LOADING POINTS

Manufacture of Cap

FINISH MACHINING OF CAPS

THE cap or nose of the fuze is made from a brass forging. The first operation bores and counterbores the chamber for the time pellet and taps the inside thread which screws onto the stem of the body.

The operation which finishes machining the profile of the caps (shown above) requires a great amount of continuous exertion, and in consequence is considered one of the most arduous of all operations in connection with the No. 80 fuze, due to the fact that the cutting tool is engaged by a continuous pressure of the arm. In spite of this women do all of this work. The ten machines in this department together turn out over 17,000 caps a day.

THREADING SET SCREW HOLES

The illustration at the right shows one of the simpler drill operations on which skillful operators have worked up tremendous speed. Three girls who work on these drills complete more than 12,000 a working day, and a record for a single girl on an eight-hour shift is very close to 5,000. The purpose of the set screw is to hold the cap firmly in place after it is threaded onto the stem.

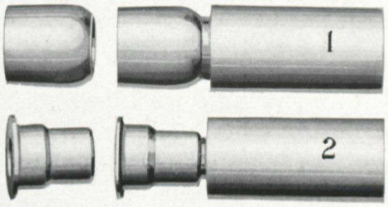
SIZING SET SCREW HOLES AND THREADING CAPS

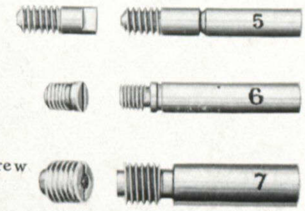
The illustration above shows one of the very few hand operations still continuing in the Company's plants. The previous operation usually leaves a slight burr or roughness, which would prevent screwing the cap onto the stem of the body. The girls in this department remove the burr and size the thread. The new operatives are "broken in" on this work, as the first part of their training for handling the more difficult machine work.

GOVERNMENT INSPECTION, TIME RINGS, CAPS AND BASE PLUGS

THE FIRING ELEMENTS

THE No. 80 fuze contains the small parts shown in the illustration below. The numerous small parts which make up the firing elements are made in a separate department on Brown-Sharpe automatic machines. These machines are about as human as it is possible to have machinery; brass rods of various sizes are fed in and each part machined and cut off to length, as shown below.





1. Ferrule.
2. Percussion Pellet.
3. Time Pellet.
4. Time Pellet Screw.
5. Wrench Pin.
6. Base Plug Filling Screw
7. Percussion Pellet Screw.

INSPECTION OF SMALL PARTS

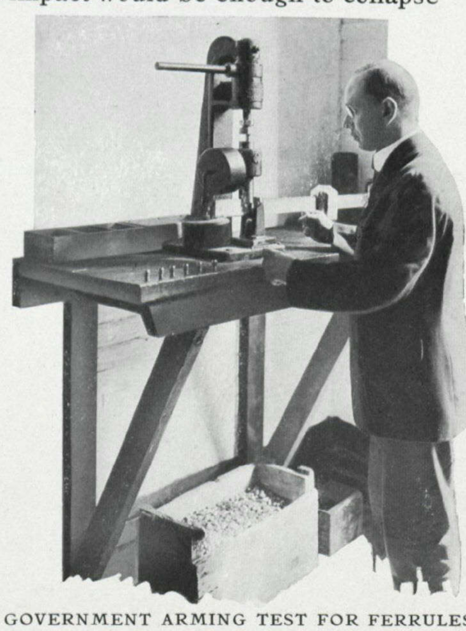
The methods used in their inspection are similar in nature to those followed out in the inspection of the fuze bodies, that is: superhuman accuracy and infinite care applied to the minutest details of countless thousands of exasperating little parts that must be right, and in this department the women, with sharp eyes and sensitive fingers trained to find fault where others see only perfection, work over the time pellets, percussion pellets and plugs, ferrules, base plug screws and other parts that are turned out by the Brown-Sharpe automatics, described above. Illustrations of these machines are shown on pages 45 and 46.

SHOP INSPECTION OF SMALL PARTS

Government arming test for Ferrules

HEAT TREATMENT OF FERRULES FOR ARMING

THE vitals of the fuze consist of the two pellets containing the detonators, the stirrup springs and the ferrule. More rests upon their perfect co-ordination than upon the most delicate human organ, for upon the latter but one life depends. The action of the percussion pellet is as follows: When the gun is discharged the impetus is great enough to collapse the stirrup spring and force the ferrule up to the shoulder of the pellet, making of the three elements, i.e., pellet, spring and ferrule, one unit. This is called arming the percussion pellet. This unit, however, is still held in position away from the firing needle by the creep spring. If the shell in flight should hit anything or the timing mechanism fail to function before the shell hits the ground, the impact would be enough to collapse the creep spring and impinge the detonator onto the firing needle. An incredibly slight shock will explode the shell after the pellet is "armed." Ordnance men say that the shell hitting a twig in flight would explode. A study of these actions will make it plain that two very important properties are required of both the ferrule and the stirrup spring, namely: they must yield at one pressure, and must not yield at another ever so slightly less. This pressure may not vary more than 100 pounds in either direction—a most delicate fraction considering that it is exerted in a mass of steel moving through the air at a speed of over five hundred miles an hour. In the case of the ferrule, this calls for an annealing process of the utmost delicacy. These ferrules are treated at 1400°F. for a period of ten minutes, which brings them to the proper plasticity. The annealing is followed by an acid bath to remove traces of oxidation. After this they are gauged and must come within an allowance of .0005″. The pellet is also held down to the same microscopic proportions, for the slightest variation in these elements alters their relation to each other and hence effects the pressure at which the pellet will arm.

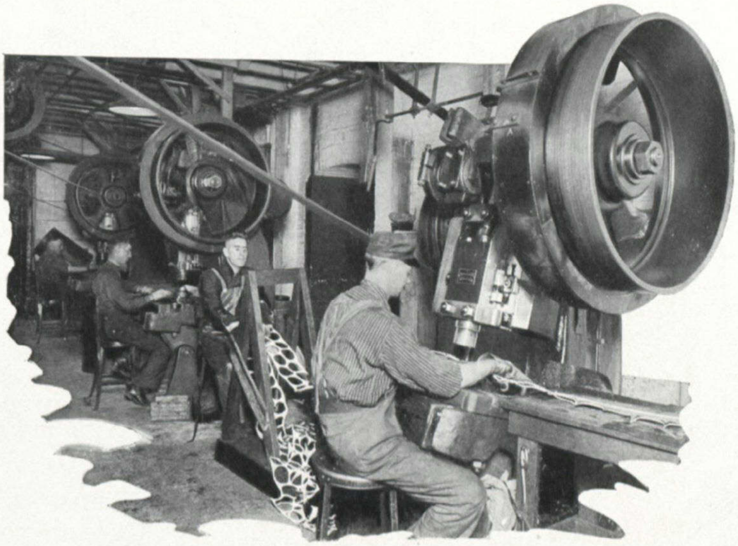


GOVERNMENT ARMING TEST FOR FERRULES

Brass Stamping Department

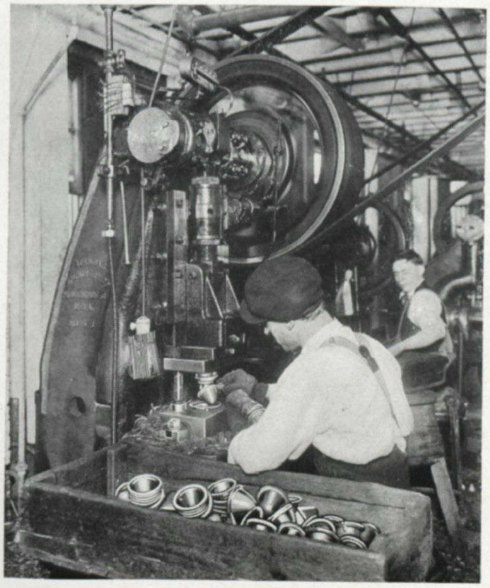
THE No. 80 fuze is protected by a brass capsule or cover which is soldered to the tinned edge mentioned on page 18. These covers and the few small parts which can be stamped are made by a separate organization in the building at King and Duncan Streets. These covers are stamped out of sheet brass on machines which have a capacity of 35,000 per day.

A second operation is required to finish the work —that of trimming the edge. This is done on a power press.



BLANKING AND FORMING COVERS

Two of the most important parts in the functioning of the No. 80 Fuze are the percussion pellet stirrup spring, and the time pellet stirrup spring. Both of these parts are stamped out on special machines, working at high speed and efficiency, out of sheet brass, annealled and gauged to precise limits. Both of these springs have very narrow limits, in pounds pressure at which they function. If the limits are exceeded, they would function at the wrong time, with probable disaster not only to the crew manning the gun from which they were fired, but to the gun itself.

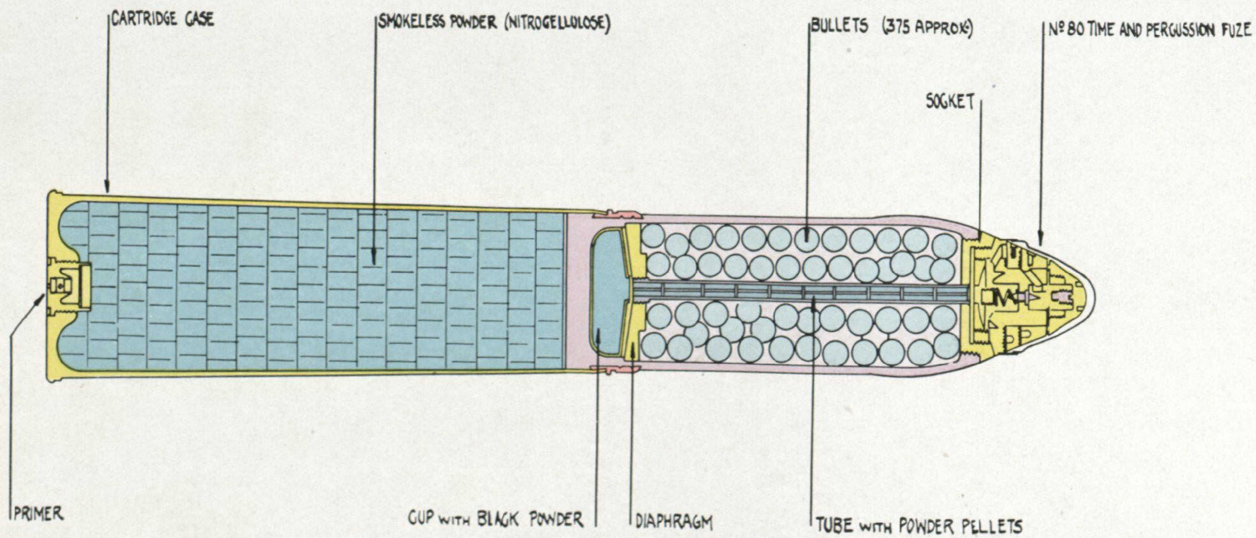


TRIMMING COVERS

While, therefore, the automatic stamping out of these little springs seems simplicity itself when watching the operation of the machine, it must not be overlooked that some expert has worked and thought carefully to make sure that perfect springs are cut out and will not only do their job right but at the right time. The production of these springs was the most delicate work done in the stamping department.

FINAL GOVERNMENT INSPECTION OF BODIES

FACTORY INSPECTION OF TIME RINGS, CAPS AND BASE PLUGS



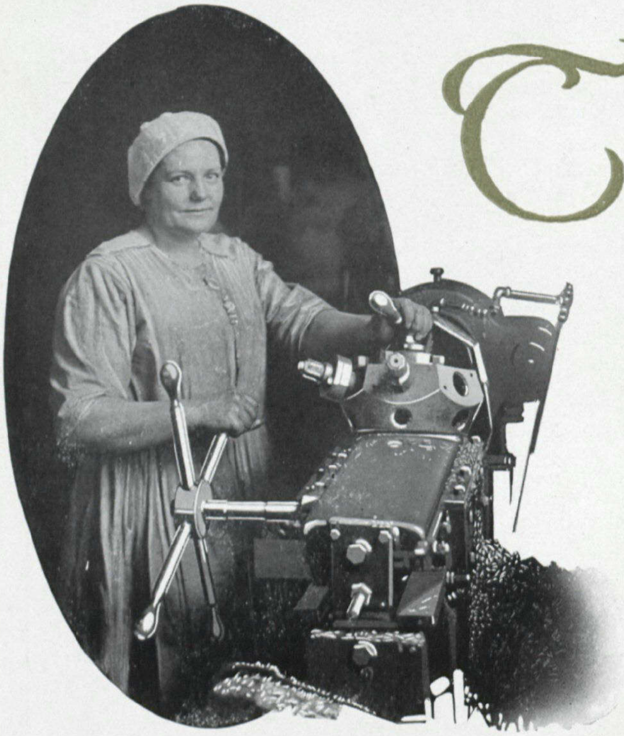
The BRITISH 18PR SHRAPNEL SHELL

The WOMEN BEHIND – *the* MEN BEHIND *the* GUNS

IN its war work it has been the policy of the Company to utilize female labour wherever possible, and the accompanying illustration clearly shows the working out of this policy at its several plants. Here the "morning shift" is shown leaving the Company's building at King and Duncan Streets, after a period of strenuous activity on No. 80 Time and Percussion Fuzes.

Intelligence, industry, and an inspiring sense of duty have enabled the Company's workers to keep a stream of munitions steadily flowing to our valiant defenders on the battlefields of Europe.

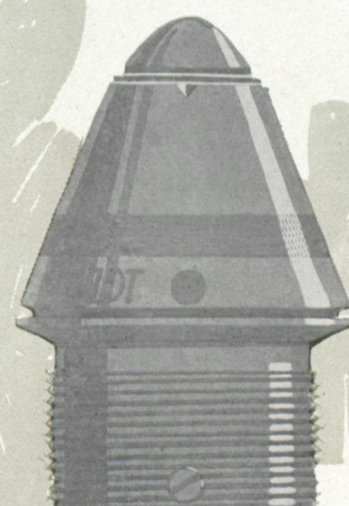
A VETERAN MUNITION WORKER



TRULY a veteran in the munitions business! She has been at it, in England and Canada, since her thirteenth year. Her experience covers work on Lyddite shells, bombs, fuzes, gunpowder, and practically every form of ammunition produced to back up the past and present fighting men of the British Empire. She, too, has passed through the "danger zone" in her country's cause, having experienced the shock of two explosions and also having been twice attacked by gunpowder poisoning. Still she "carries on," and daily with heart and eye and hand she labors to aid our men in the mighty task that called them overseas. In the illustration you can see the Munitioneer's Medal she is wearing, and she is still intent upon adding other bars to those she has already so faithfully earned. Women of her type made Britain great; may Britain never lack daughters of similar courage and loyalty!

The illustrations on this page show this operator working on the second operation on caps. She is handling a Turrett Lathe, and producing about 2,400 caps a day at one of the most arduous and exacting processes in the whole manufacture of fuzes. This operator has a record showing her to be one of the steadiest operators in munitions manufacturing in Canada.

101 GRAZE FUZE



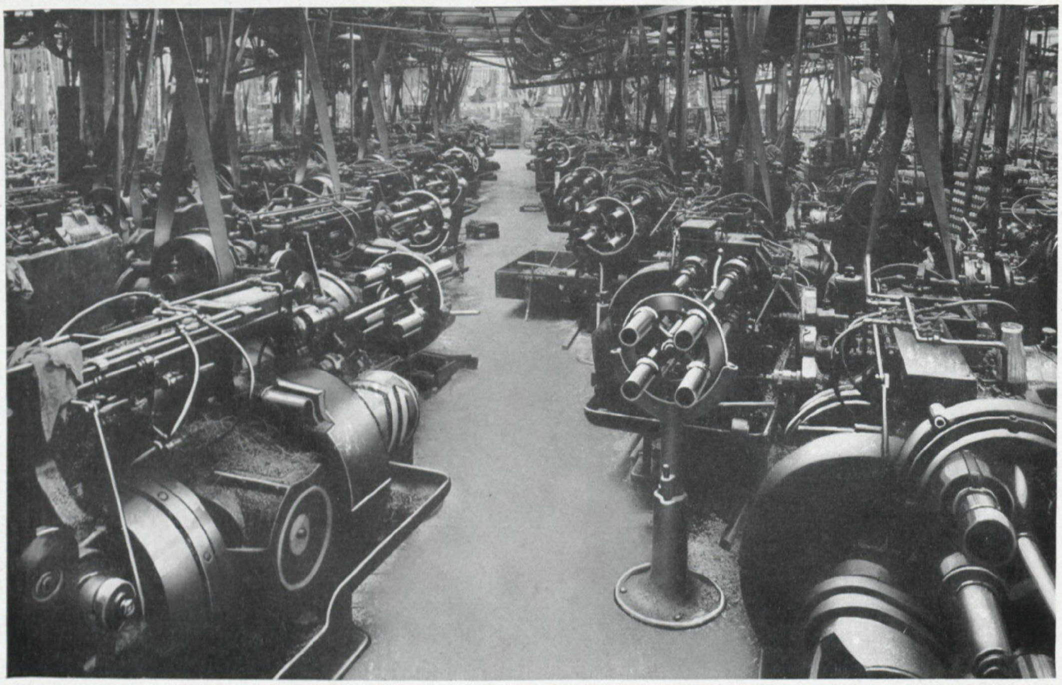
Manufacture of the No. 101 PERCUSSION FUZE

THE No. 101 fuze is percussion only, and hence its construction is simpler and it contains fewer parts than the No. 80. The body, cap and adapter—it has no rings—are made of bar steel, and the firing elements of brass. Its operation is as follows: When the shell is fired its forward force causes the detent spring to compress and the detent and detent socket to drop into the detent hole, and catch there. This action frees the centrifugal bolt which is thrown against the centrifugal bolt plug by the rotation of the shell, thus unlocking the percussion, or graze pellet. Hence during the remainder of the flight the pellet is held away from the needle by the creep spring alone. At contact the creep spring is compressed and the burst follows.

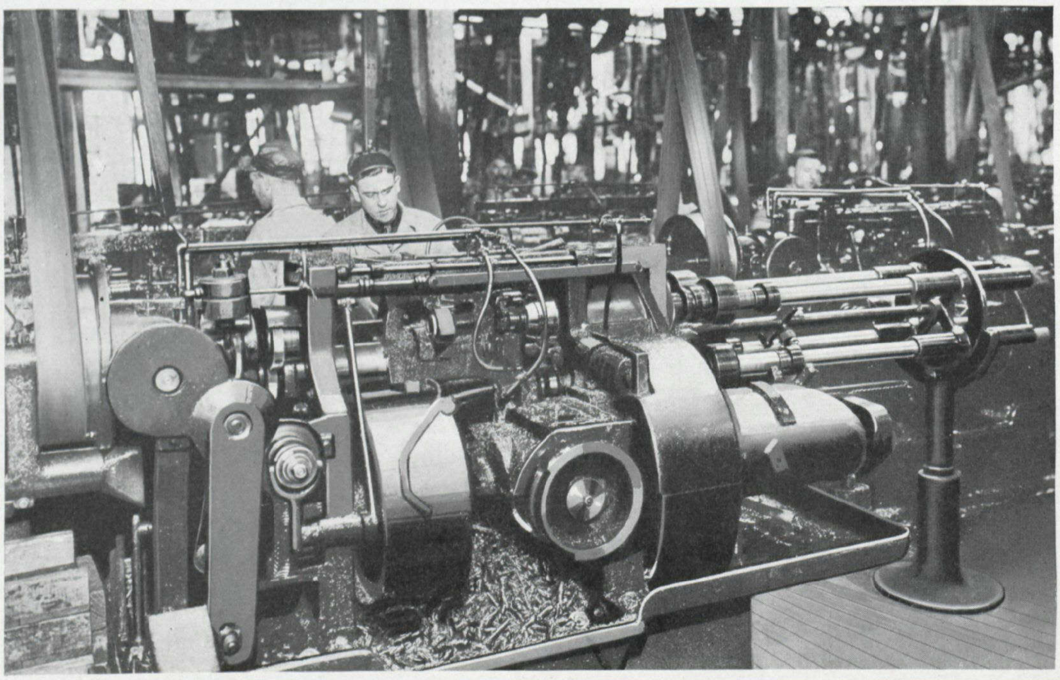
SECTION OF BAR STEEL STOCK ROOM

¶ The steel for the body is received in this form: bars 8 feet in length and $2\frac{13}{32}$ inches in diameter. In the manufacture of the 4,500,000 No. 101 fuzes by the Company over four hundred and twenty-five miles of bar steel were used.

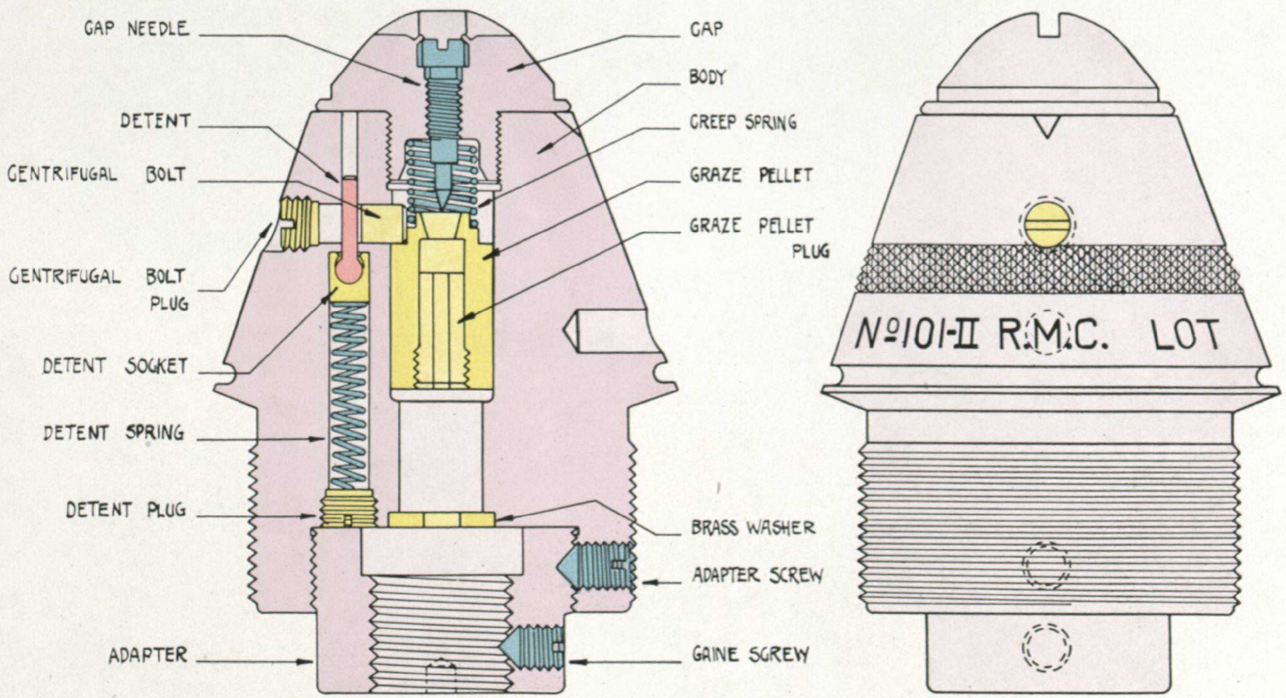
¶ Men do the first operation on the bodies. The steel bars, four at a time, are machined in a multiple spindle automatic screw machine. These rough shape the



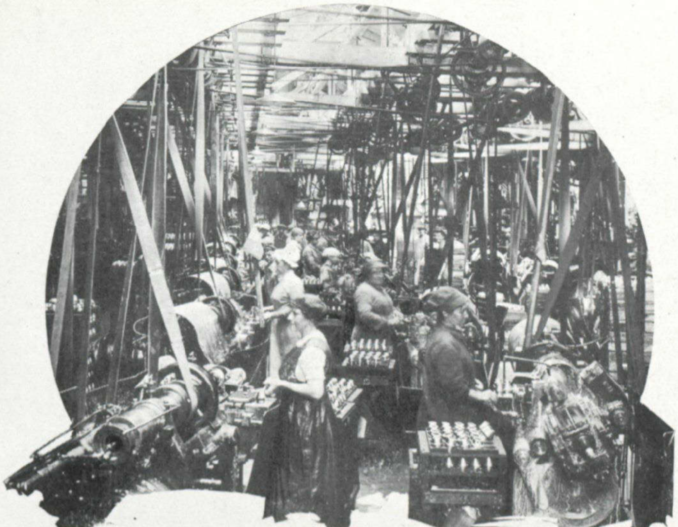
GENERAL VIEW OF MACHINES FOR BODY MAKING



MACHINING BODIES ON MULTIPLE SPINDLE AUTOMATIC SCREW MACHINES



The BRITISH PERCUSSION FUZE
Nº101



MACHINING GRAZE PELLET HOLE ON SINGLE SPINDLE AUTOMATIC

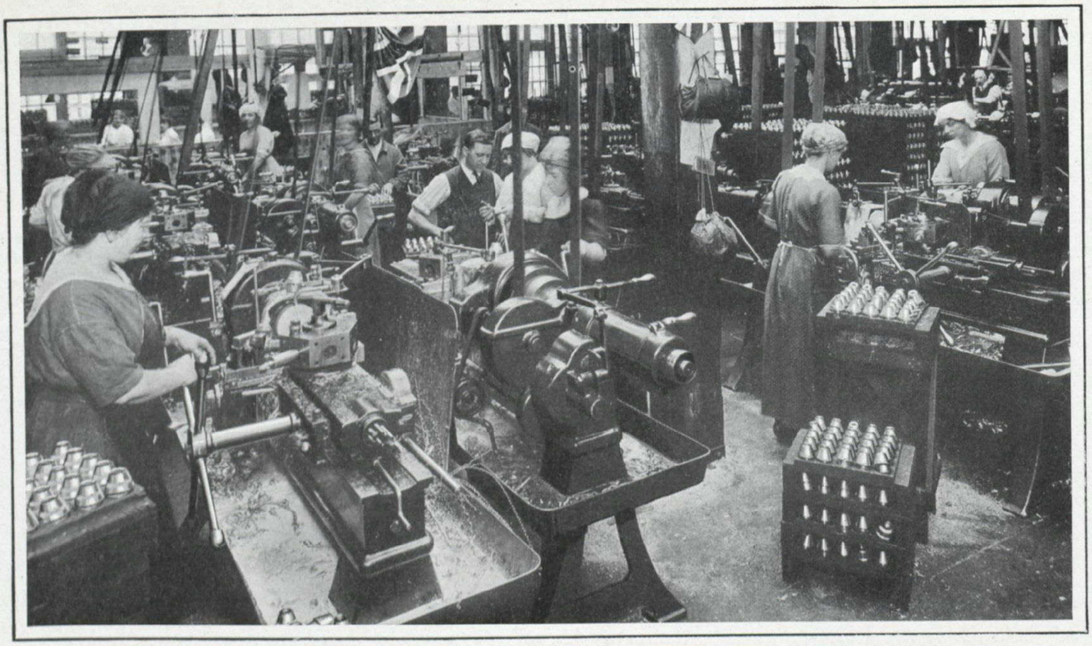
body, drill the pellet hole and cut the body off to the proper length, a set of operations taking 70 seconds (see illustration on page 36). After machining, the bodies are washed and inspected, and the burr caused by the boring of the pellet hole is removed by a hand operation. The second machining operation, done by women, on single spindle automatics, is reaming the graze pellet hole and facing the seating surface for the cap. This machine finishes the work on the pellet hole with the exception of cutting the thread for the cap. Time 50 seconds.

At the completion of the work on the pellet hole the body passes to a battery of turret lathes where the outside tapering surface undergoes three finishing operations. These lathes cut the groove at the base of the taper, shave the surface to absolute size, and cut the knurl. The twenty lathes working on this job have a combined capacity of 35 a minute. The tapping of the thread for the cap, which is a six-second job, finishes the stem end of the body.

At this point the drilling commences. These operations cover the detent socket hole; the detent hole, a smaller sized extension of the first; the centrifugal bolt hole; a wrench hole, which is used when the fuze is screwed onto the shell; and a set screw hole. The drilling of the detent hole is a very delicate operation; until the present method used in the Company's shops was devised the results were often unsatisfactory. The difficulty arose from the fact that the detent hole—very narrow and long in

INDIVIDUAL VIEW MACHINING GRAZE AND PELLET HOLES

INDIVIDUAL VIEW SHAVING AND GROOVING BODY

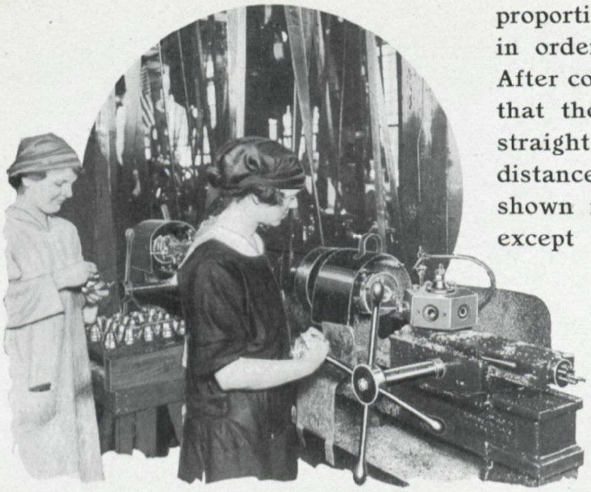


GENERAL VIEW SHAVING, GROOVING AND KNURLING TAPER END OF BODY

COUNTERBORING AND FINISHING ADAPTER END READY FOR MILLING

GENERAL VIEW OF SMALL DRILL LINE

GENERAL VIEW OF THREAD MILLING DEPARTMENT



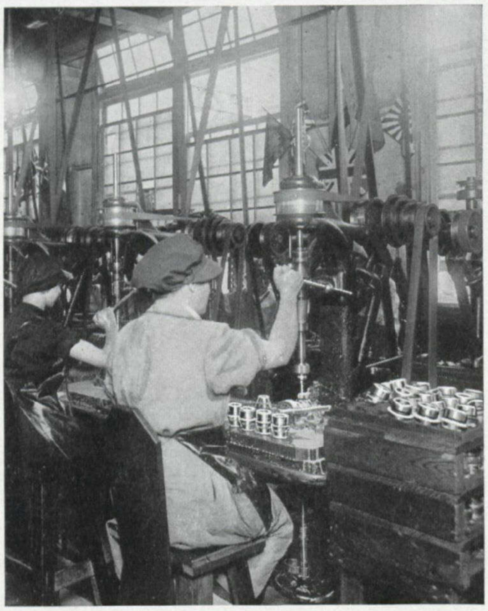
DRILLING DETENT HOLE

proportion—had to be drilled absolutely straight in order for the detent to function properly. After considerable experimentation it was found that the only certain way to drill this hole straight was to use three drills to go a distance of $\frac{3}{4}$ inch. These operations, shown in the opposite illustration, are similar except for the section of the hole drilled. These drilling and tapping operations take 6 to 12 seconds each, giving a total time of $2\frac{1}{2}$ minutes a fuze.

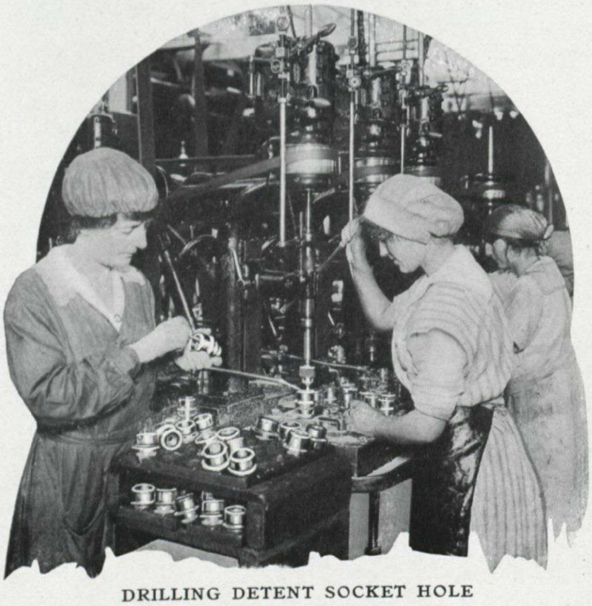
There are twenty-one machines doing this work, each with a capacity of three every two minutes.

After the drilling operations a complete shop inspection is made in this department. As in the case of the 80 fuze, there are inspectors overseeing every operation as it is finished. This inspection is carried on the same way as that of the time fuze: and "go" "no go" gauges are used in addition to a visual inspection.

The illustration on page 39 shows the thread milling operations carried on in this department. These thread millers cut off the thread on the outside of the fuze body which fits into the nose of the shell. The method is similar to that used in thread milling the nose and base of the 9.2 shell. The milling of the outside thread takes 50 seconds and of the inside, which is the same sort of a process, 45 seconds. There are fifty women on each shift employed on these two operations.

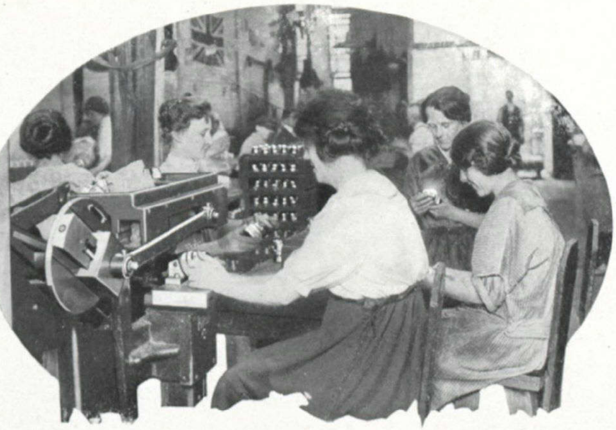


CLOSE-UP VIEW DRILLS FOR CENTRIFUGAL BOLT HOLES



DRILLING DETENT SOCKET HOLE

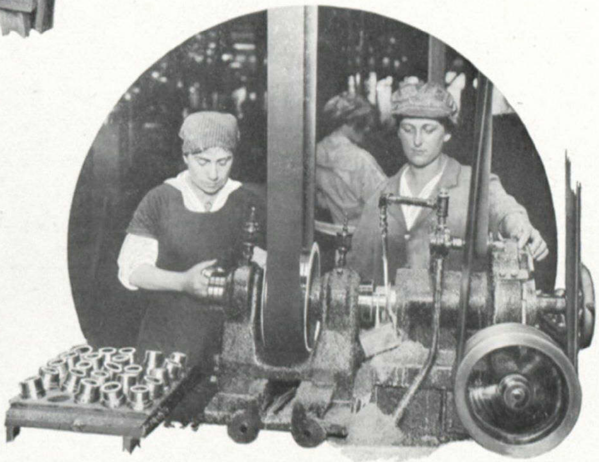
Every fuze is stamped with its number, lot, and the initials of the company which made it. The machine



STAMPING NAME AND NUMBER ON FUZE BODY

stamps everything except the lot, which is determined and stamped on later. Three operators are required to handle this stamping machine, one to feed, one to handle, and one to unload. The skilled workers on this machine are a fine example of scientific team-work, and are able to average 4,800 every eight hours on each machine with little or no difficulty.

Following the stamping, a large department of finishers take the product in hand and carefully go over it for imperfections. This is the final operation before the plating, and hence the last opportunity for the inevitable inspectors to look for trouble. In this instance the trouble takes mostly the form of rough edges thrown up by the machines, and these are all burred and finished off here.



MILLING THREAD ON OUTSIDE OF BODY

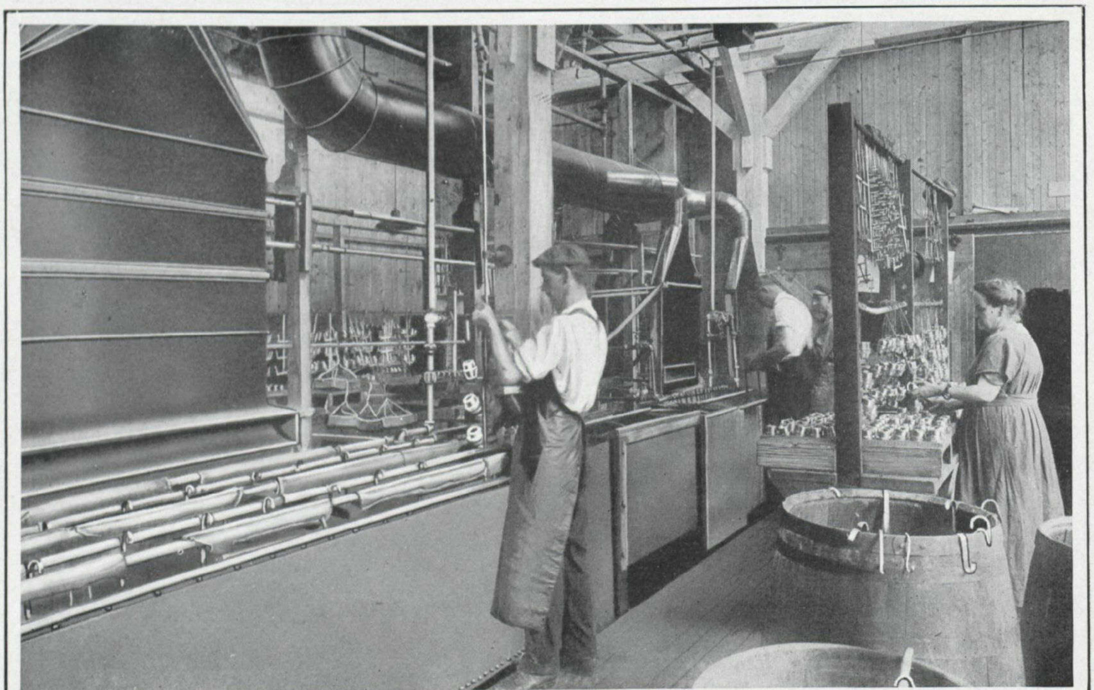
BURRING AND FINISHING BODIES BEFORE PLATING

ELECTROPLATING

AS the bodies arrive in the electroplating room they are mechanically perfect, but questionable from the standpoint of cleanliness, due to their passage from oily hands, through oily machines, to other oily hands, to have a "go" in another oily machine. And off this oil must come, and off it does come, for in the Company's plant they have very ingenious chemists, who change the oil to soap, and thus make the fuzes wash themselves. After they have thus washed off the oil by changing it to soap, they wash off the soap with acid, and then the acid with water.

The plating itself consists of hanging racks of fuzes in a cyanide of copper solution until sufficient copper is deposited to coat the surface thoroughly. Then they are washed again, first in hot water, then in cold water, then in chemicals, and finally the whole business is blown off clean with an air blast; 26,000 fuzes are so cared for each day, as well as nearly 90,000 screws and needles.

One of the noteworthy things about the electroplating establishment is the manner in which the workmen are protected from the fumes of cyanide. This method, forehanded, like most of the Company's methods, instead of drawing off the fumes after they reach the air, draws them away as soon as they reach the surface of the solution, so that they never get into the air at all.

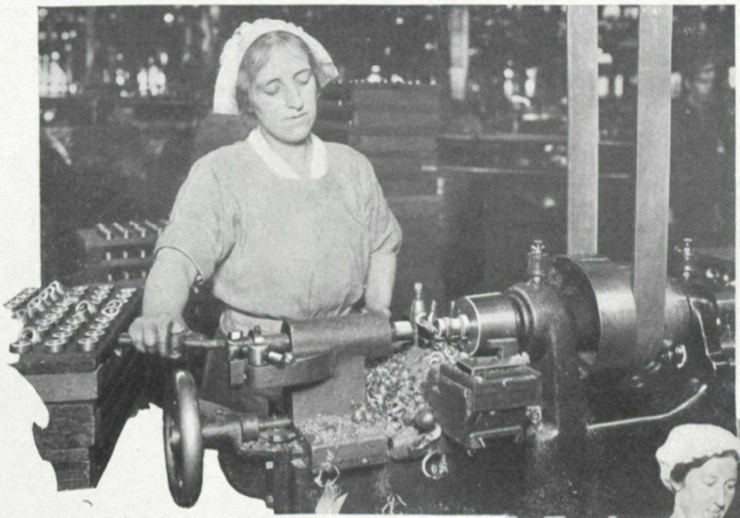


CORNER OF ELECTRO-COPPER PLATING ROOM

The Adapter

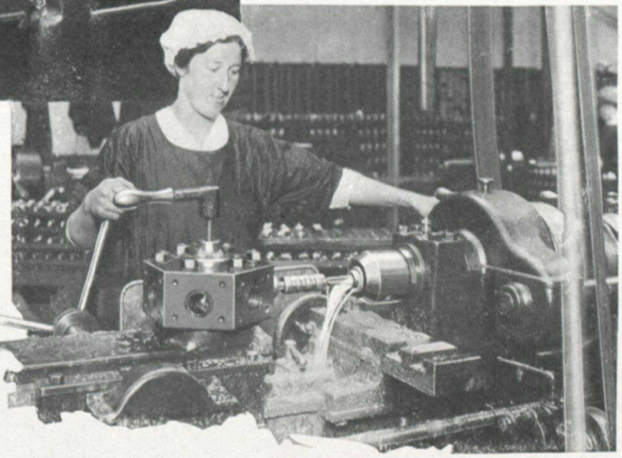
A COUPLING-PIN carries no freight, yet there are few indeed, if any, who would disparage its usefulness in the make-up of a freight train. The adapter, the manufacture of which is shown in the two photographs on this page, is another one of these bits of apparatus which are more useful for what they get others to do than for what they do themselves.

The purpose of the adapter is to carry the flash which is brought about by so much skill and hard work in the fuze, down into the charge in the shell where it causes the explosion. To some extent the work on the adapter, which, with the exception of the first operation, is carried on by women, is similar to that on the fuze body.



FACING ADAPTER TO LENGTH

For the first process, a one and three-quarter inch multiple spindle Gridley automatic forms, drills, reams, bores and counterbores and then cuts the adapter from the steel rod. This machine operates at the rate of 70 adapters an hour.



THREADING INSIDE OF ADAPTER

In the facing process shown above the women operators can turn out 3,500 adapters a day. They face the adapter to length and chamfer the bevel on the Gaine end of the hole. The remaining operations on the adapter are threading the inside, drilling and tapping the set screw hole, and drilling wrench hole. The photograph above shows the tapping of the inside or Gaine hole thread of the adapter. This tap is put on at the rate of one every twenty seconds. A later process re-taps and trues this thread.

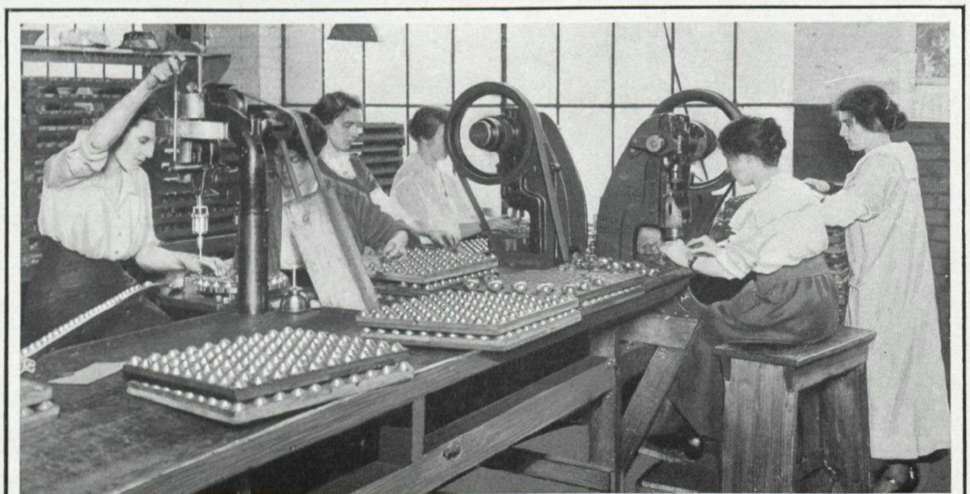
The Cap

THE cap, or nose, of the fuze contains the needle which causes the detonation of the charge in the graze pellet. The rough machining and the cutting of the outside thread are done on an Acme automatic multiple spindle machine, with a capacity of 1,400 per twenty-four hour day. Subsequent operations finish form the head and drill and counter-bore the needle hole, a semi-automatic hand screw machine being used; mill the screw driver slot in the head, tap a thread for the needle and burr. The screw driver slot

MACHINING CAP

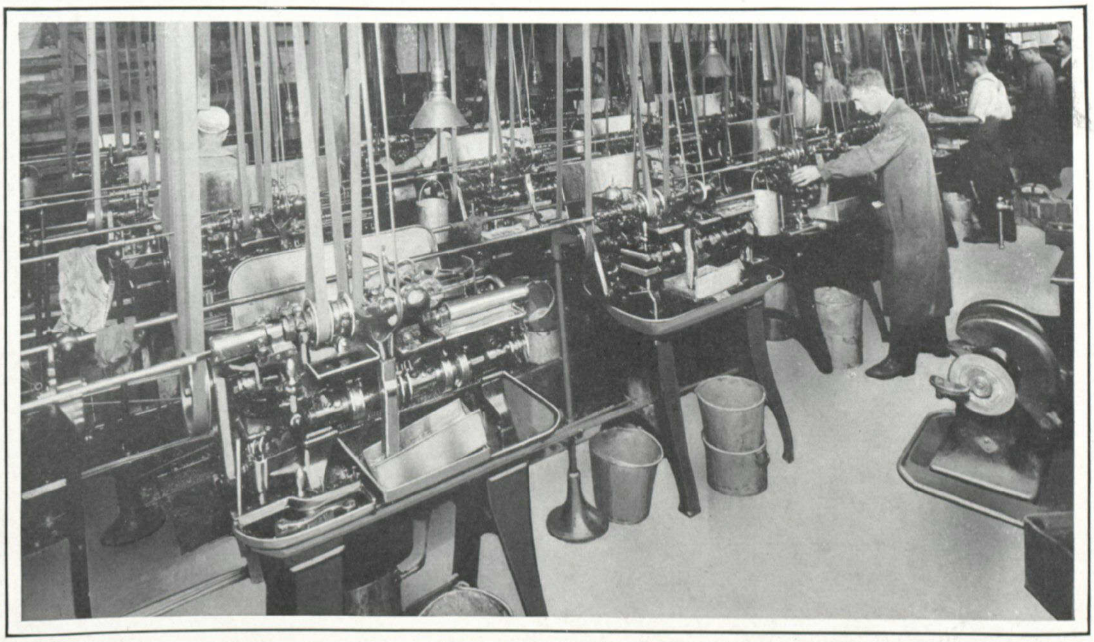
MILLING SCREW DRIVER SLOT IN CAP

is milled on a hand feed machine at the rate of approximately 600 per hour. By far the most important operation on the cap is the assembling of the needle. A specially designed semi-automatic is used in this work, and great care is taken that the needle, which is not only threaded into the cap,



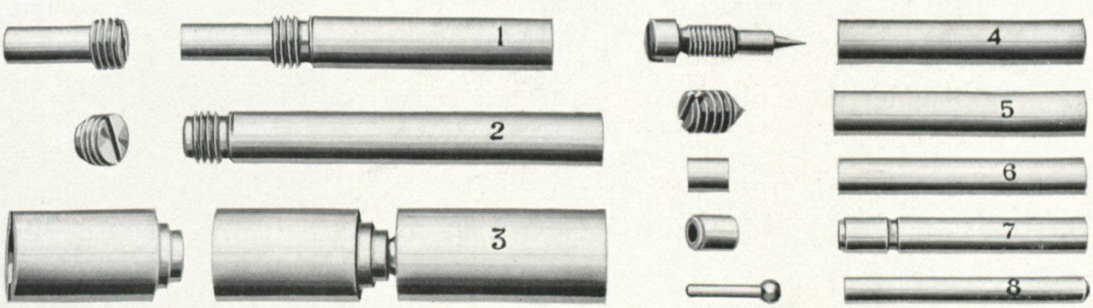
ASSEMBLING AND STAKING NEEDLE IN CAP

but permanently affixed with cement, is screwed down firmly and to the proper distance. Its length is gauged from the face of the cap to the end of the needle and only .02 inch is allowed for variation in this measurement. The lower illustration on page 44 shows the assembling and staking of the needle in the cap.



BATTERY OF AUTOMATIC MACHINES PRODUCING SMALL PARTS FOR FIRING ELEMENTS IN THE TIME AND GRAZE FUZES

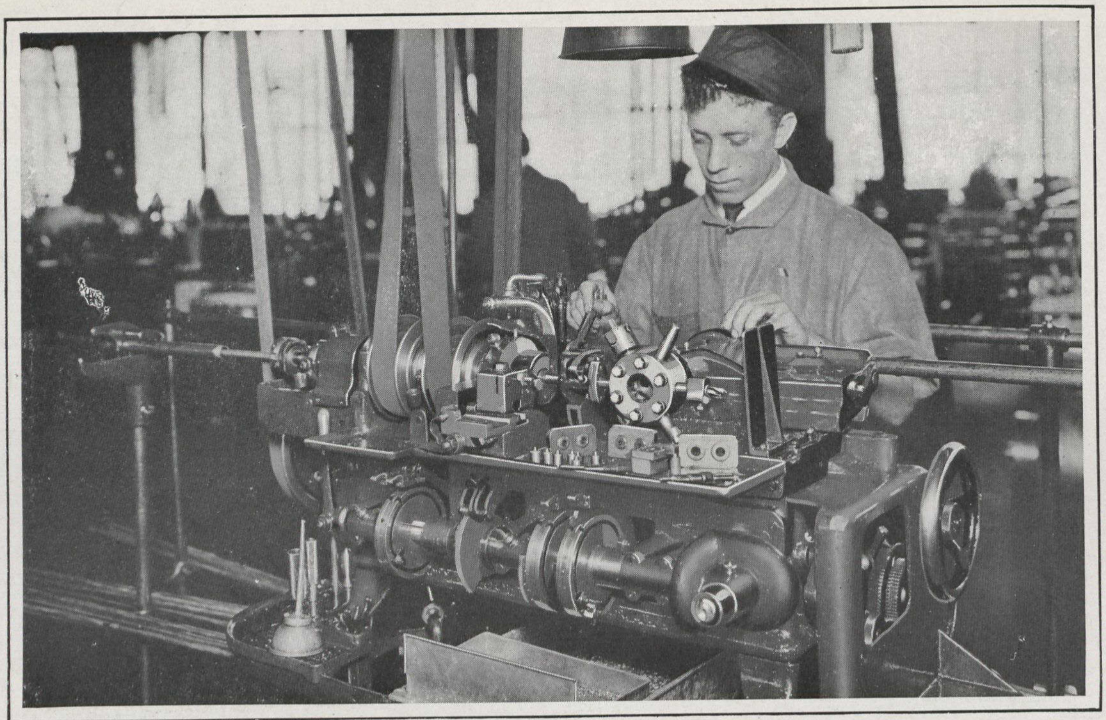
On the machines shown above are made the numerous small parts that make up the firing elements of the fuzes. The automatics on these processes work with as near human intelligence as it is possible for machinery to have. About all that they seem to require is an occasional feeding with another rod or two of brass. Beyond that they work alone. Some of them will do as many as seven or eight different operations.



1—Graze Pellet Screw.
2—Detent and Centrifugal Bolt Screw.
3—Graze Pellet.
4—Needle.
5—Adapter Screw.
6—Centrifugal Bolt.
7—Detent Socket.
8—Detent.

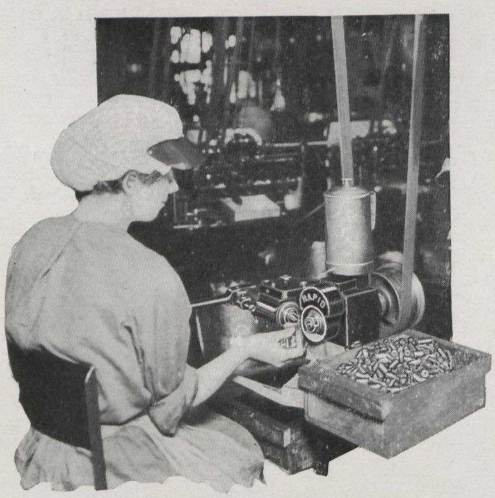
SMALL PARTS MADE BY THE ABOVE MACHINES

A certain thread is to be tapped, requiring perhaps two seconds. An amusing steel finger jumps into position with a dignified little jerk; it has finished the thread and jumps out of position with an equally dignified little jerk. Two seconds exactly.



BROWN-SHARPE MACHINE MAKING GRAZE PELLETS

Another finger, just as prim and methodical, takes its place. This one may mill a slot, or ream a drill hole, or machine a tiny surface. Its time allowance may only be five seconds, or perhaps as many as forty. In either case it does its work and goes on its way, while the rest wait patiently their proper turn. And as each unit is finished an uncanny metallic arm reaches down and removes it. Plenty of oil they require, and plenty of material—but of human attention or interference they are more independent than a cat. The automatic shown in the above picture is making graze pellets. It does seven different jobs on each pellet, in fact finishing the pellet except for cutting a slot in the base end, and turns out 4,500 a day.



MILLING SCREW DRIVER SLOT
GRAZE PELLETS

The girls milling the slot in the graze pellet are turning out thirty-five to forty thousand every twenty-four hours.

ASSEMBLING DETENT AND SOCKET

The detent and detent socket are assembled by means of a ball and socket joint—an arrangement which allows the detent to move about freely and thus to catch in the detent socket hole as the spring is compressed. Two girls operate the assembling machine—a foot press indexing die. One feeds the socket, the other operates the machine with her foot and feeds the detent. They can turn out eight to nine thousand a shift.

LUNCH ROOM, ASSEMBLING AND INSPECTORS STAFF

The remaining small parts that make up the detent section of the fuze are all assembled by hand, as shown on page 48—the centrifugal bolt, the centrifugal bolt plug, the detent, detent spring, and detent plug screw. The girls working on this can assemble about two hundred fuzes per hour. The exact significance of this figure can better be appreciated after you have tried to do the same thing and have lost the detent spring, your temper and your thumb nail in so doing.

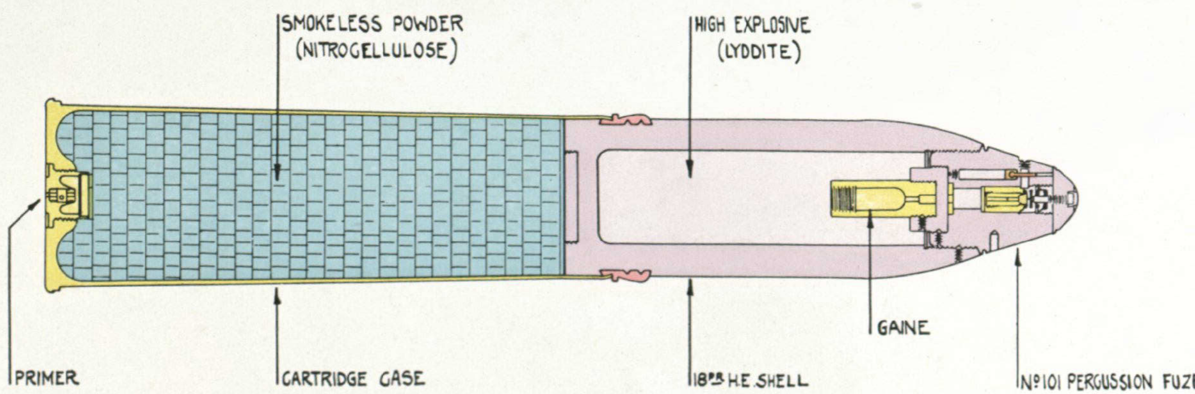
PACKING FUZES FOR SHIPMENT

On account of the long journey the fuzes have to make and the hard knocks they are apt to receive before they get where they can give a few themselves, it is necessary that each one be packed in a substantial individual package. The shipping room shown in the picture below, where approximately twenty-five thousand fuzes are packed and shipped every day, houses one of the busiest departments of the Company's organization.

PACKING FUZES FOR SHIPMENT TO THE FRONT

ASSEMBLING

GENERAL VIEW OF ASSEMBLING ROOM



The BRITISH 18 PR HIGH EXPLOSIVE SHELL

THE FIRST CONTRACT

No. 100 "GRAZE FUZE"

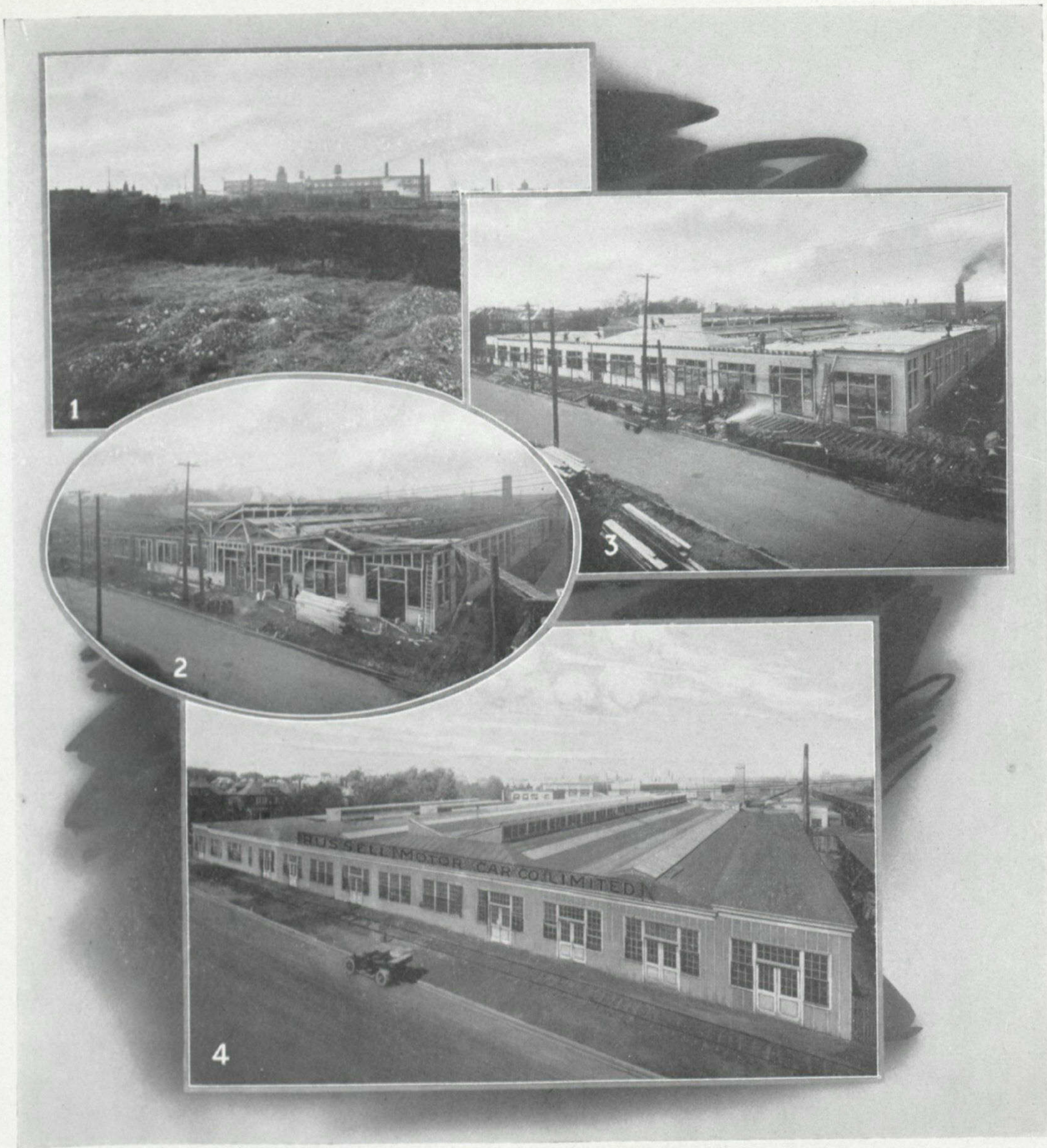
PRODUCTION of the No. 101 Fuze has been on such a vast scale and the output so notable that the Company's first contract for graze fuzes has been somewhat lost sight of. We must not forget, however, that while the Company's greatest production was in the manufacture of the No. 101 Graze Fuze, that its first efforts were concerned with the No. 100 Graze Fuze, the first British fuze of this type used in the Great War.

In fact, this Company's work on the No. 100 Graze Fuze was the first attempt that had ever been made in Canada to manufacture a shell fuze of any description.

This contract was secured in the summer of 1915, the initial order being for only 500,000, and only 700,000 were manufactured altogether when the No. 100 was superseded by the improved No. 101.

However insignificant this work may now seem in the light of subsequent outputs, the fact remains that the Canadian history of the manufacture of this type of munitions starts with the No. 100 Graze Fuze in the factory of the Company. Many things have happened since that the Company can justly be proud of, but still in the "First Contract," the beginning of it all so far as the Dominion is concerned, there is something that should not be forgotten, and should not be overlooked, in the Munition Records of Canada.

A careful study of the plates showing the parts of the No. 100 and No. 101 Graze Fuze will indicate the difference in the mechanism of the two. The No. 101 was considered a great improvement over the No. 100 and completely superseded it. The diagram of No. 100 Graze Fuze is shown facing the following page.

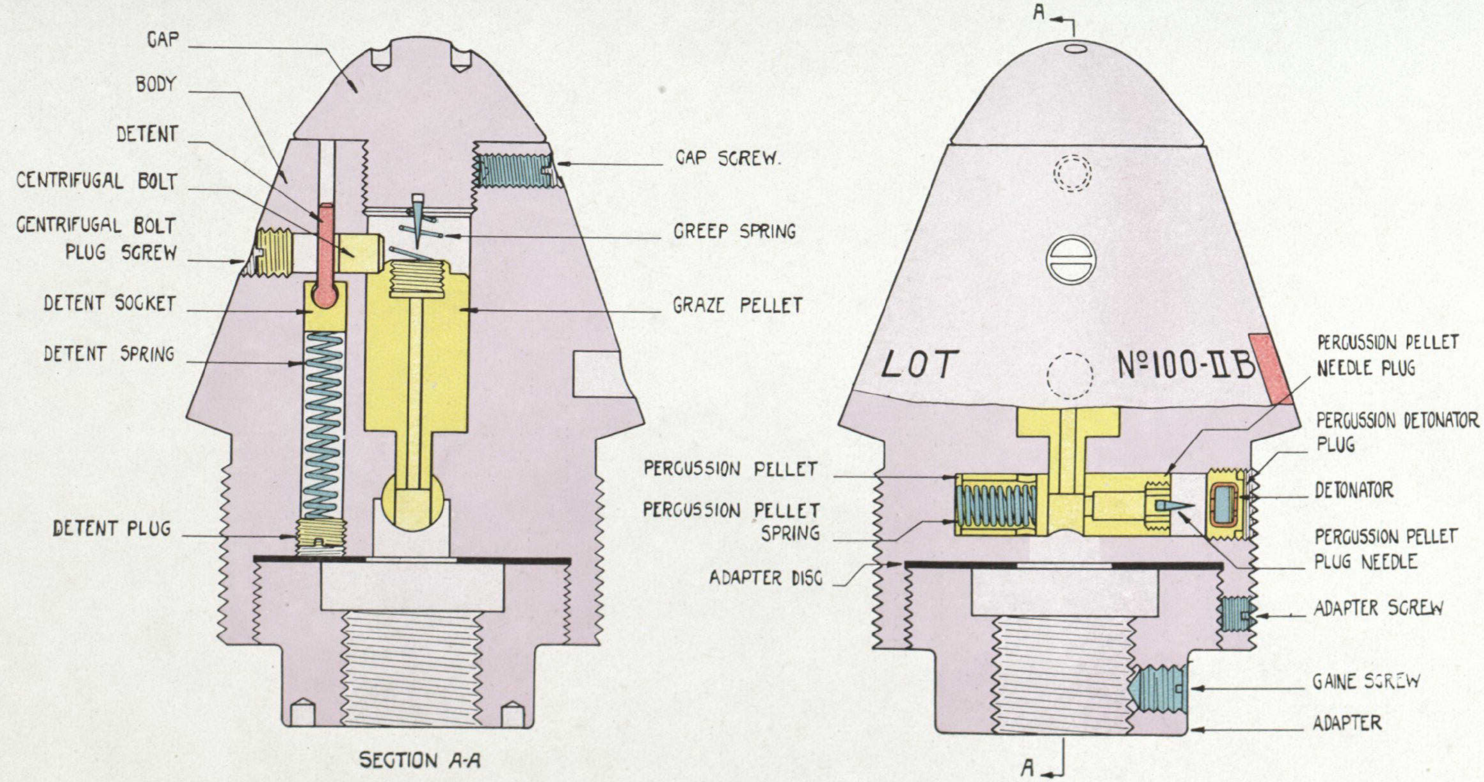


No. 3 PLANT OF RUSSELL MOTOR CAR COMPANY, LIMITED
UNDER CONSTRUCTION

No. 1—15th September, 1916. No. 2—29th September, 1916.
No. 3— 6th October, 1916. No. 4—27th October, 1916.

The first contract for No. 100 fuzes was successfully completed in the summer of 1916. So urgent was the demand from the Front for munitions that the Company had hardly finished this contract when it was given the task of increasing its daily production four-fold, in an incredibly short time. This meant larger premises, more machinery, a new army of employees and extraordinary efforts on the part of all concerned.

The pictures above show how the initial job—getting the necessary factory space—was handled, and all in 42 days.

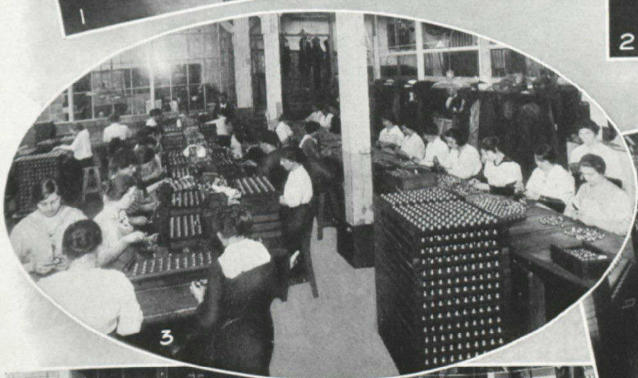


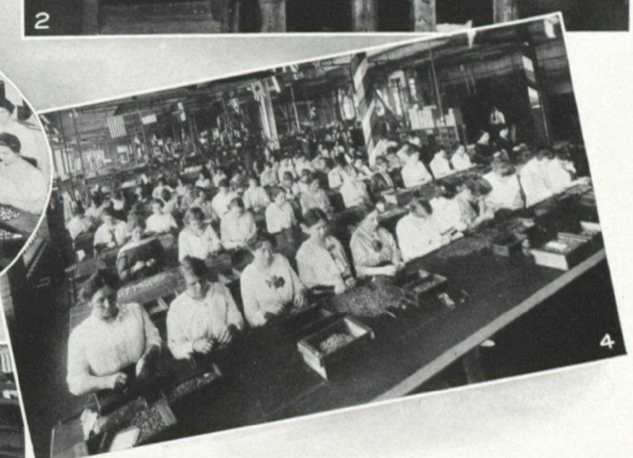
The BRITISH CRAZE FUZE Nº100

GAUGES and INSPECTION

IF the doing of it were not so important the telling might become tiresome—this business of gauges and inspection.

No secret service system was ever so thorough, so persistent, so all pervading as the corps of inspectors whose members guard the exits from every department that no part go through without their knowledge, and who are to be found at your very elbow ready to pass judgment on the work you have just set down.





No. 1—FINAL SHOP INSPECTION OF BODIES.

No. 2—INTERMEDIATE SHOP INSPECTION AFTER DRILLING OPERATIONS.

No. 3—FINAL SHOP INSPECTION OF ADAPTER.

No. 4—SMALL PARTS SHOP INSPECTION ROOM.

No. 5—FINAL GOVERNMENT INSPECTION ROOM.

Not even do the bars when first drawn at the mills escape them, for these too are subjected to the minutest scrutiny for detecting the faintest traces of flaws and defects.

And in the manufacture of the fuze inspection follows inspection—not a single operation is overlooked.

The first series of inspection is carried on at the machines themselves. Every part is inspected as it is produced, and the unsatisfactory parts discarded or finished properly before going further.

There are a sufficient number of inspectors to pass upon the output of each machine as it is finished. Ordinarily one inspector can handle the output of two machines. Often two are needed for three machines; sometimes an inspector to each machine, whereas in the simpler operations one inspector may handle the output of a battery of four or five.

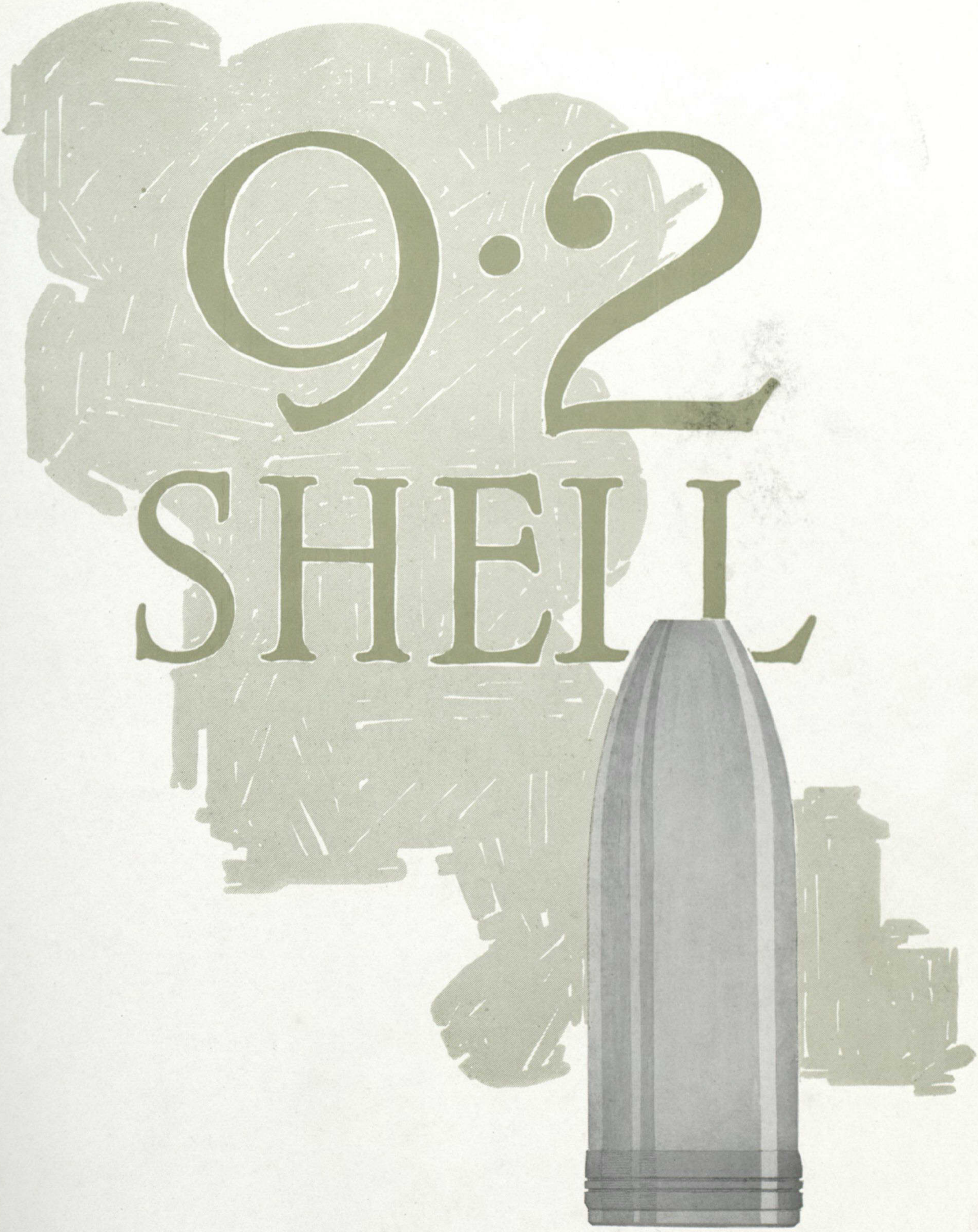
Following this inspection is the final shop inspection. This is carried on in special quarters in each department. The number of inspectors for a department ranges from 80 to 95 people, depending upon the output and part under inspection. Here a "hundred per cent.," over-all inspection is made of every detail of the part, duplicating every previous inspection. In this inspection 235 government and 50 working gauges are used for the No. 80 fuze, 162 for the No. 101, and 28 gauges for the 9.2 shell. The total number of gauges bought and used by the Company and government inspectors was 9,296.

A large portion of the plant is set aside for the use of government inspectors, who pass on the product approved by the Company's inspectors before it leaves the factory.

SUMMARY OF TOTALS

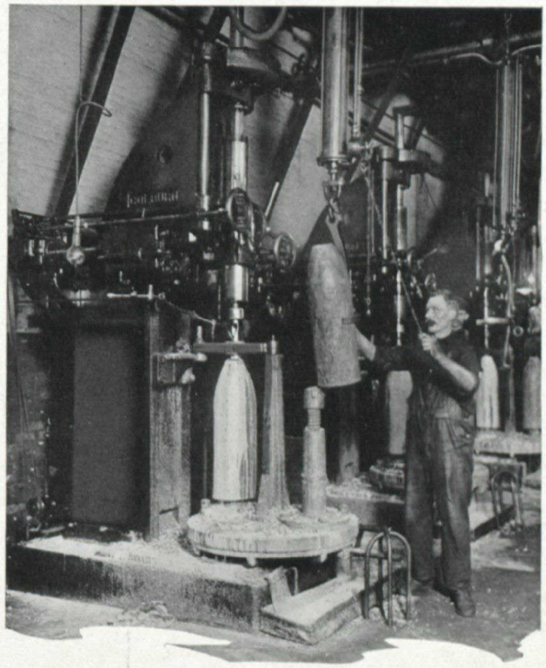
In all, there are in the three fuze plants 1,489 inspectors to pass upon the product of 4,634 workers, a ratio of 3 to 1. The ratio in the shell plant is somewhat wider on account of the difference in type of work, which allows most of the workmen to use gauges themselves in the preliminary inspection. But even here we have 127 government and Company inspectors whose whole time is devoted to passing on a daily output of 800 shells.

	Government Inspectors	Russell Inspectors	Gauges Used	Employees not including Staff and Inspectors
101 Fuze	112	650	162	2363
80 Fuze	100	500	285	1000
9.2 Shell	38	89	28	821

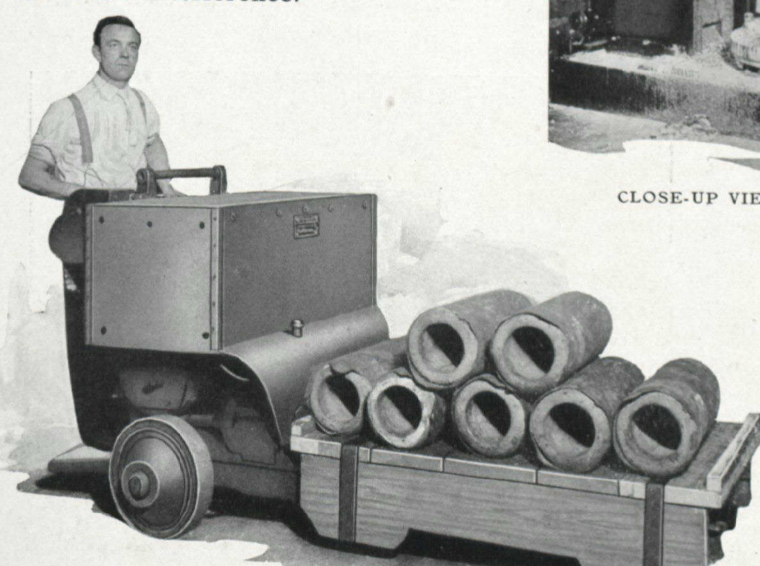

9·2
SHELL

Construction and Manufacture of 9.2 HIGH EXPLOSIVE SHELL

"THE big 9.2 howitzer was throwing its 290 pound projectile into the Hun trenches nearly 9000 yards distant. The five-mile journey was accomplished by each shell in thirty-five seconds, a rate of more than 500 miles an hour. Standing directly behind the breech I could distinctly see the 9.2 shell as it left the muzzle and started on its sinister errand." So writes Frederic Coleman in an article in one of the current magazines. I read this description shortly after I had inspected the Company's Plant No. 2, where they are turning out about two hundred tons of these brutes every day, and it appeared to me that the writer had used commendable judgment in choosing to watch these shells from the breech of the howitzer. There is nothing dainty or clever about a 9.2. There are no cunningly fashioned mechanisms and no shining brass surfaces. No delicate springs to delight the eye. Nothing at all but two hundred and fifty-three pounds of sheer destruction, accustomed when it starts its travels to ask no one's permission and to brook no one's interference.

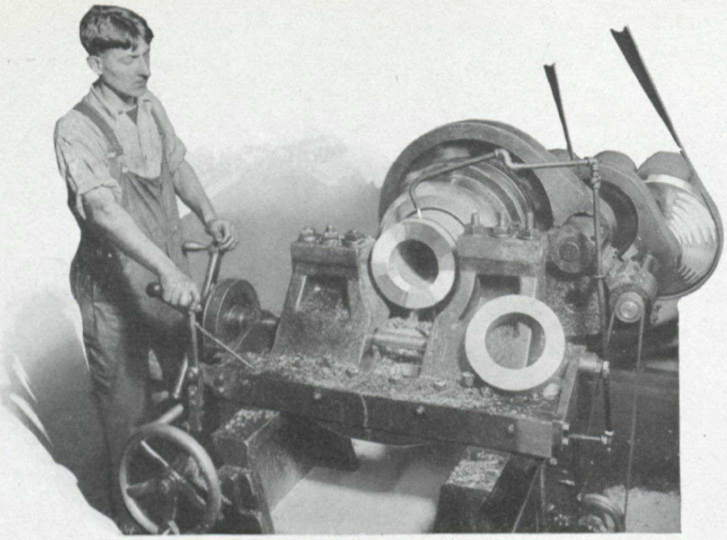


CLOSE-UP VIEW DRILLING FUZE HOLE



ELECTRIC TRUCK BRINGING IN FORGINGS

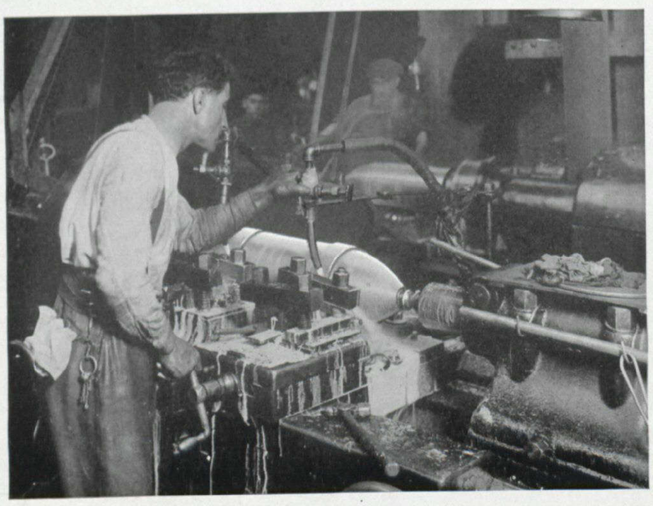
The big factory at Dufferin Street, where they are making the 9.2, the machines in it, the men who run them, all seem to have absorbed the characteristics of the big High Explosive. Here is a place where the *piece de resistance* is a 300-pound steel forging, and you



CUTTING OFF TO LENGTH

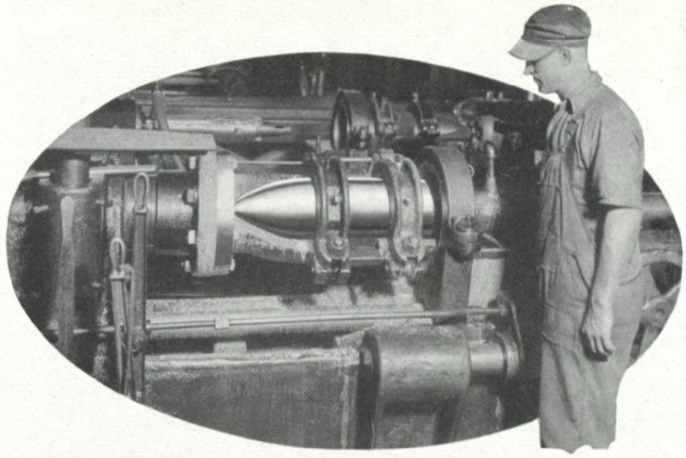
realize the minute your eyes note the thick beamed platforms, the huge solid lathes and drills, and the sturdy set-up of the men, that you are where a big job is being done in a big way. And yet, although the men who make the 9.2 are working on huger masses of metal, the fineness and accuracy of their product is subject to just as severe regulation as we have found in the case of the fuze. Should the inside surface of the shell contain the slightest irregularity the friction set up would cause a premature burst. Hence the interior of that rough, ugly forging must be machined and polished until it is as smooth and as perfect as plate glass. Likewise the outside surface finish, the exact contour, the machining of the base plug, are of high importance and subject to the most scrupulous inspection, and call for most skilful artisanship. Three separate pieces of metal figure in the completed shell as it is shipped from Dufferin Street to the loading plant: the shell proper, the base plug, and the copper band. The manufacture of the shell itself naturally comes first and its processes are more complicated than the others. The shells are received in the plant in the form of rough forgings, weighing about 300 pounds. These are brought into the plant from the loading platform on small electric trucks, as shown on page 55, large enough to accommodate seven forgings and a driver. The first operation on the forging, shown in the upper illustrations on pages 55 and 58, is drilling the nose. An air hoist places the forging on a turn table where there are saddles for two shells. The drill bores one shell at a time, and while the machining of one goes on the operator removes the finished one and puts another in place. There are five drills working on the nose and the boring takes about a minute.

At the finish of the bore the shell is measured from the shoulder of the fuze hole and marked for the next operation, which is cutting off the end of the forging to proper length, as shown above, the forging being affixed in a revolving chuck and rotated against a cutting tool.



CLOSE-UP VIEW ROUGH TURNING

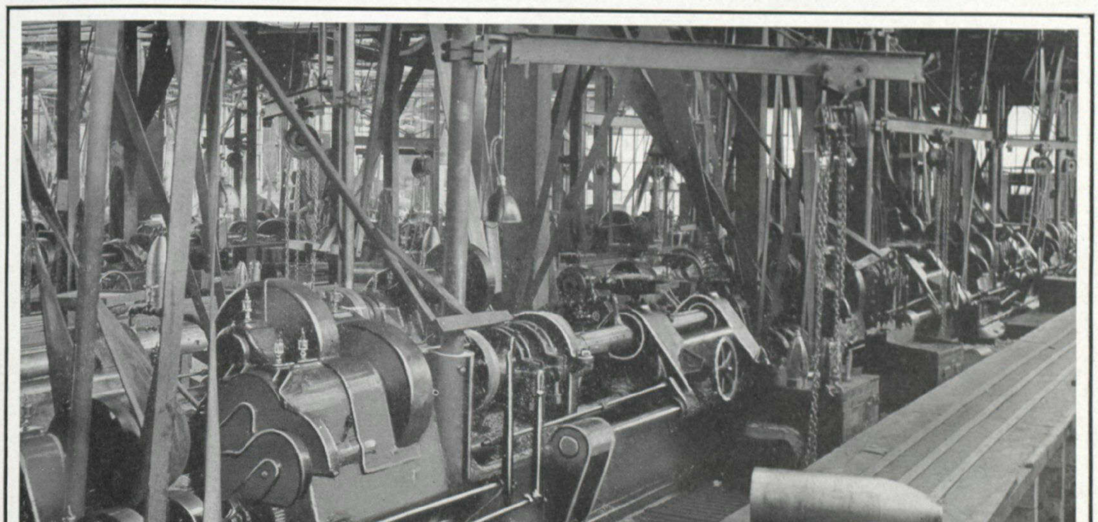
Following the cutting off of the forging to length, the outside surface of the shell is rough turned (as shown on pages 56 and 58). This operation is done on Bridgeford lathes, two turning tools being used for the work. One of these tools machines the diameter of the shell as it revolves on the arbor, while the other, running with a link motion on a cam, turns and shapes the nose.



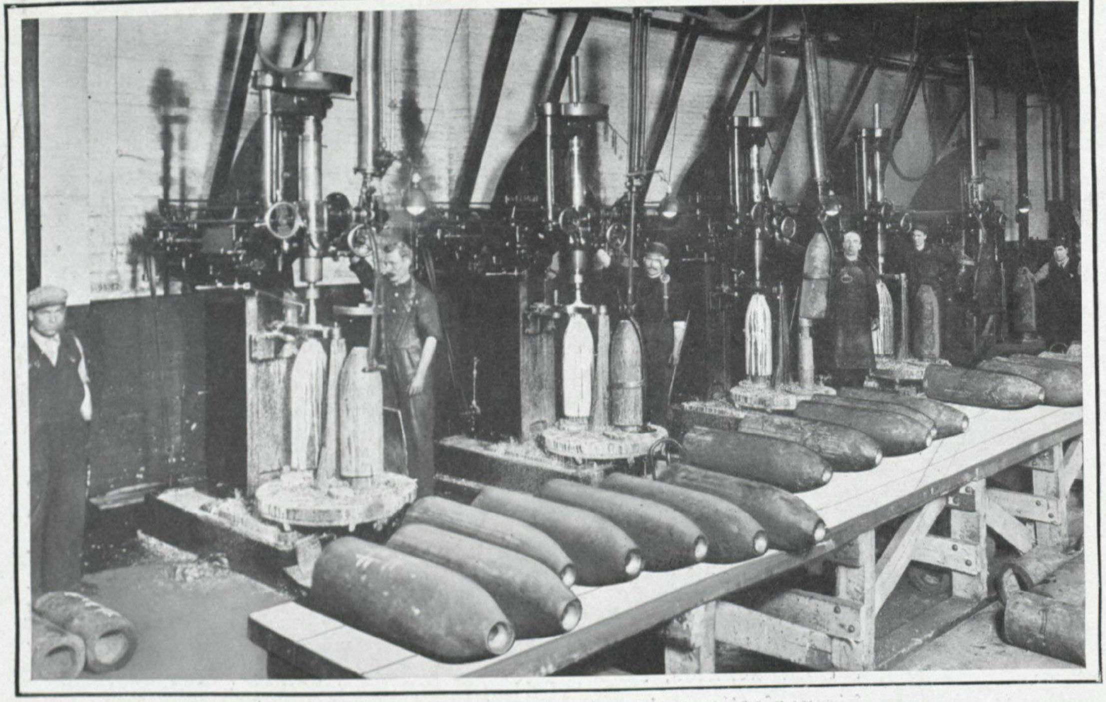
CLOSE-UP VIEW BORING DEPARTMENT

The boring operation, shown opposite, which roughs the interior of the shell, as the previous one did the outside, completes the rough work. As a matter of fact so fine is the work that this machine turns out almost a finished operation. Three cutting tools are used—a four-bladed rougher, a two-bladed rougher for the bore and profile of the nose, and a two-bladed finishing tool. One of the machines in the background shows the latter in place. The position of the shell in the chuck is shown in the foreground. After each operation, not only on this but on all the machines, the operator gauges and, where necessary, refinishes the job, or if imperfections show through in the metal he rejects the forging.

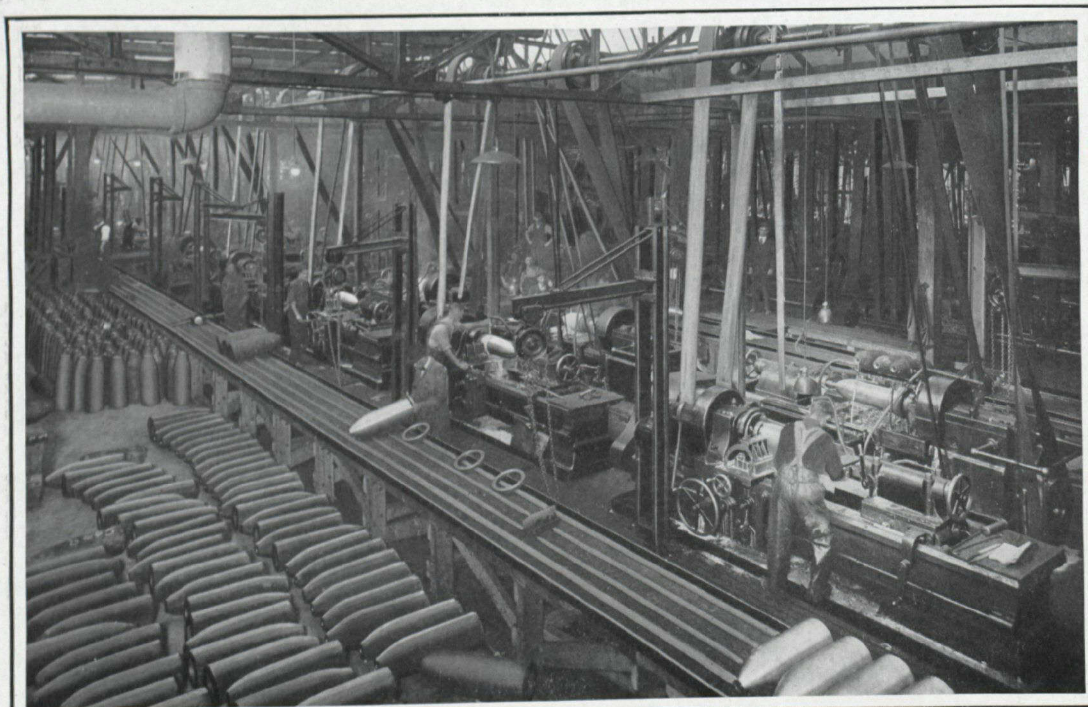
Up to this point the operations on the shell have all been in the nature of roughing



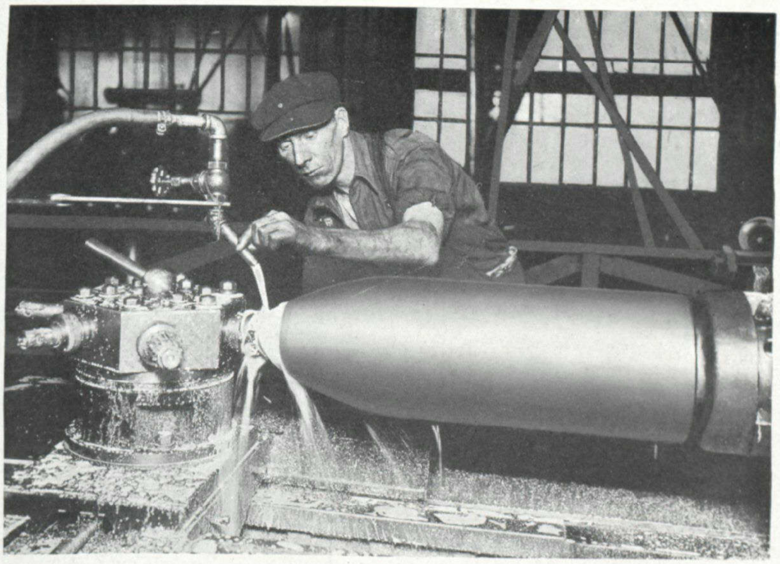
GENERAL VIEW BORING DEPARTMENT



GENERAL VIEW DRILLING FUZE HOLE AND NOSE OF SHELL

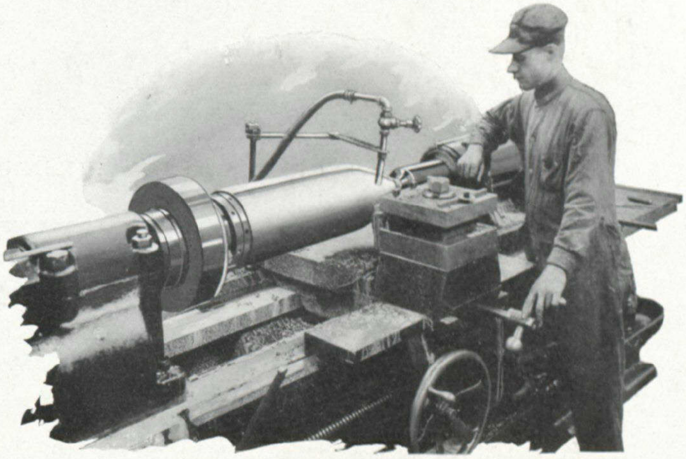


GENERAL VIEW OF ROUGH TURNING DEPARTMENT



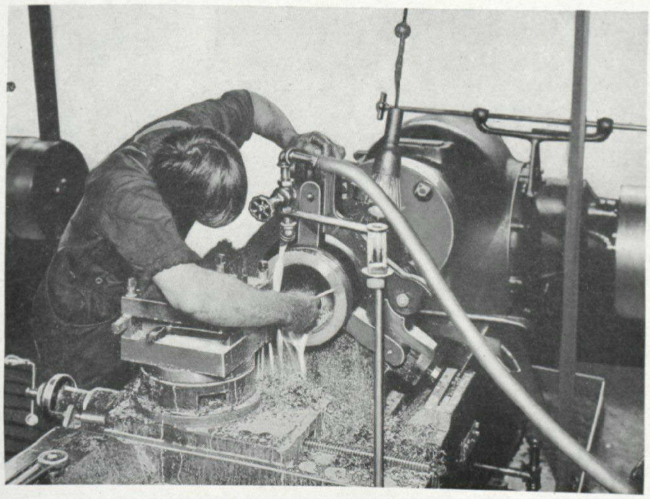
FINISHING THE FUZE HOLE

processes. The illustration shown on page 58 goes back to the fuze hole, the drilling of which was the first thing done, and finishes it with the exception of cutting the thread, which is done later on. The operator, using a seating tool, reams and bores the nose hole to the exact dimension prescribed by the gauges. The left hand illustration and the illustration on the right show the machinery and processes involved in putting the finished surface on the diameter and nose of the shell. Maintenance of the proper condition of the tools in this and similar work is of the utmost importance. Most of these tools have been designed in the Company's machine shop, and are of a superior type for this sort of work. At the same time the



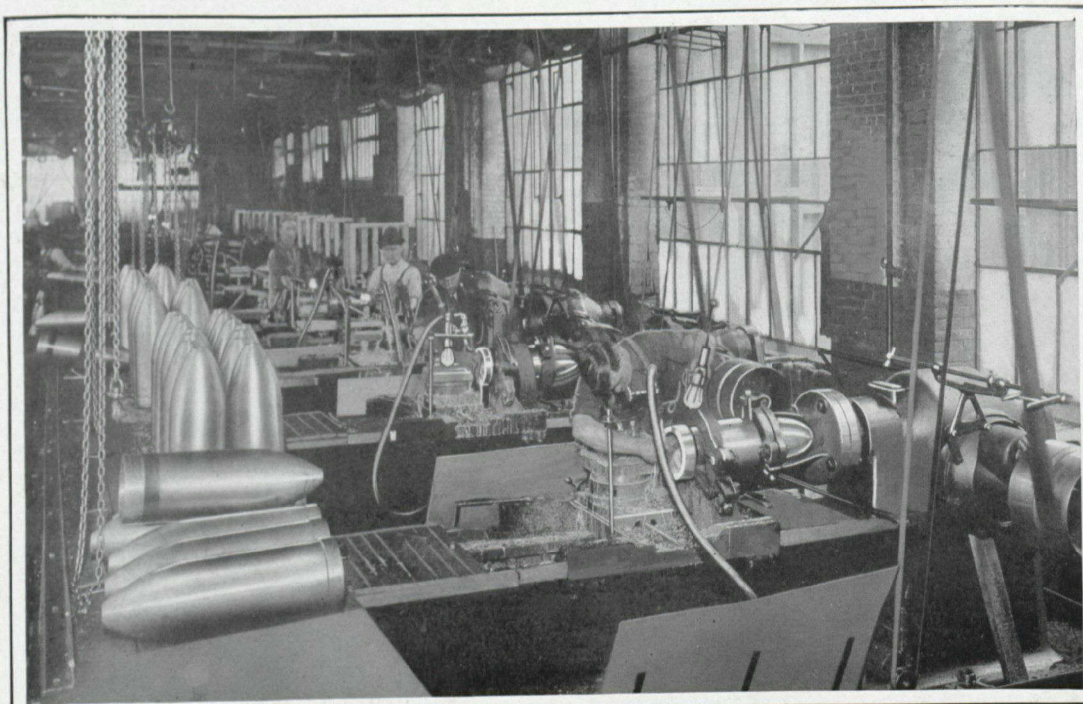
CLOSE-UP VIEW FINISHED TURNING

quality and quantity of work turned out depends absolutely upon the skill of the operator—not upon the depth of cut his tool makes, nor his quickness in getting the finished job out and the new job in—but in his knowledge of just what depth cut his tool will do most efficiently, and just when it ought to be replaced with a sharper one. Before the bore of the shell can be finished the base end has to be counterbored. This counterbore is later threaded,

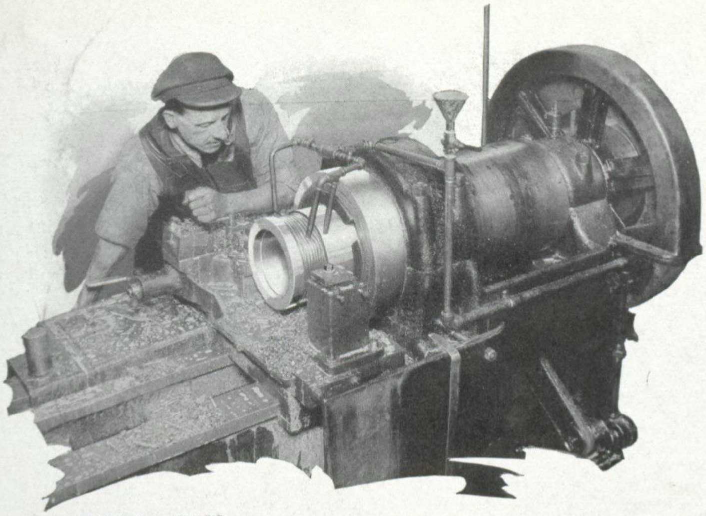


COUNTERBORING BASE END

GENERAL VIEW FINISHING TURNING



GENERAL VIEW COUNTERBORING BASE END

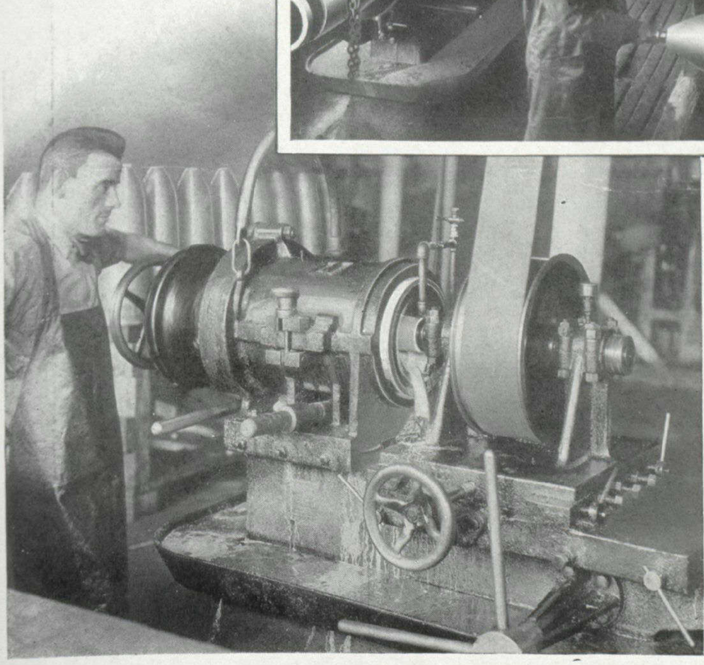


CLOSE-UP VIEW
GROOVING AND
WAVING

for screwing on the base plug. The illustrations on pages 59 and 60 show the operator gauging the finished counterbore.

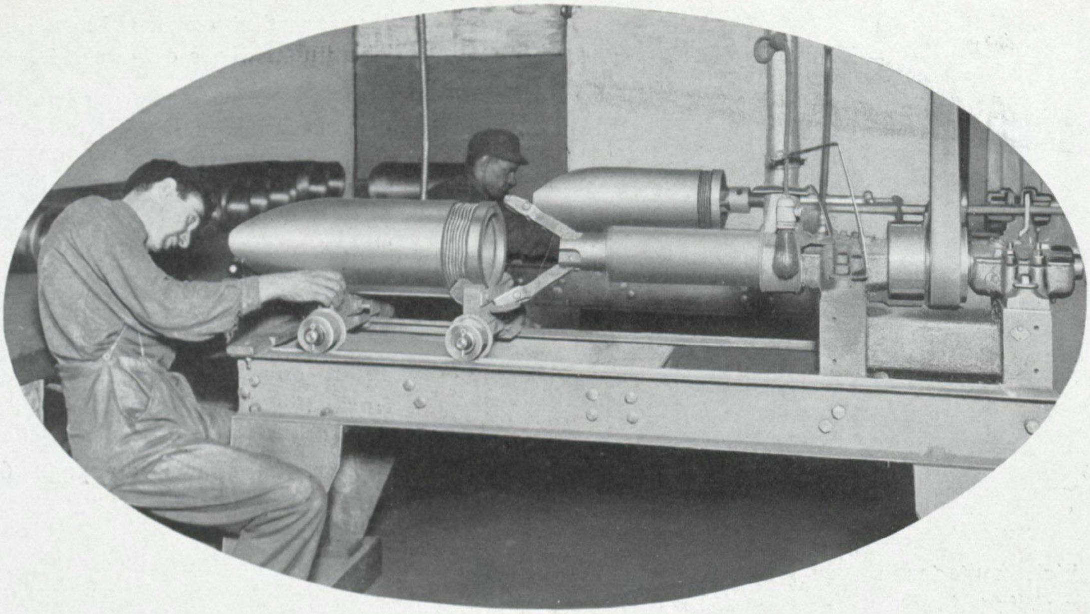
The final operation on the outside diameter is that of cutting and waving the groove (as shown opposite and in lower illustration on page 62). This groove is a cut about four inches in width and .27 inches deep, about one-fifth of the way up from the base end. Into this is later pressed the band of copper, as shown on page 63, which engages the rifling of the gun and imparts to the shell the revolving motion which keeps it on a straight course.

GENERAL VIEW OF THREAD
MILLING DEPARTMENT

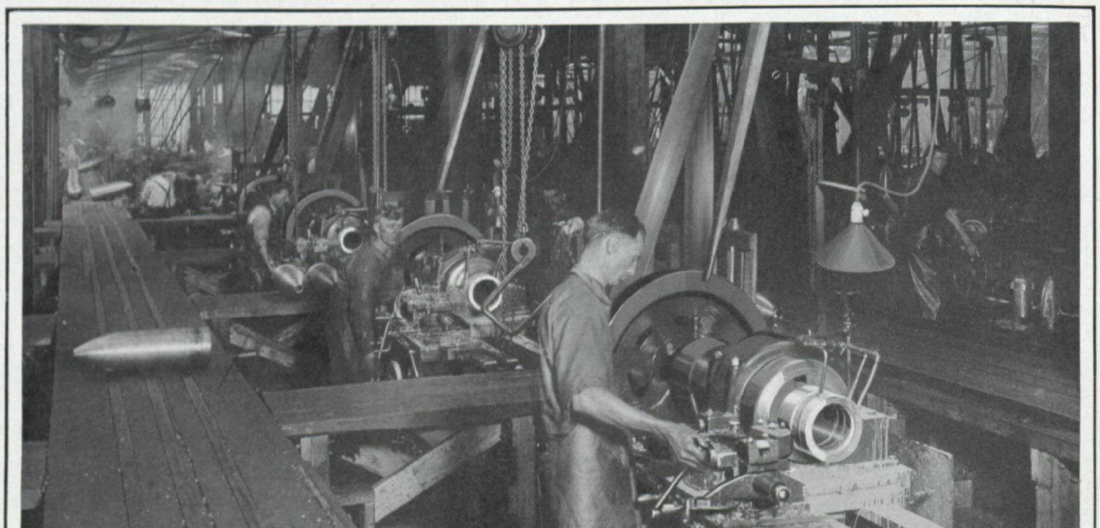


THREADING INSIDE BASE OF SHELL

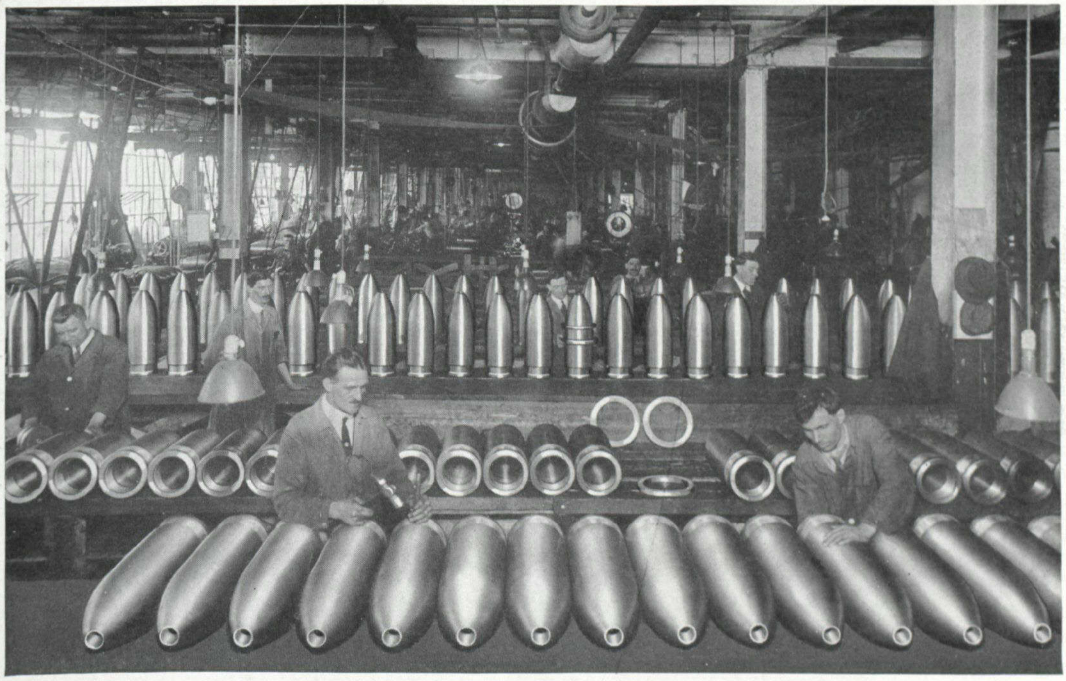
For this work the shell is held in a chuck and revolves on a cutting tool, which first marks and then cuts the groove. The waves are cut in the bed of the groove and the edge of the groove is undercut in order that there be no possibility of the copper band slipping out of place when the shell is fired from the gun. The motion of the waving tool is given to it by a wheel which rests against the end of the chuck, which is shaped.



FINISHING GRINDING INSIDE OF SHELL



GENERAL VIEW GROOVING AND WAVING DEPARTMENT

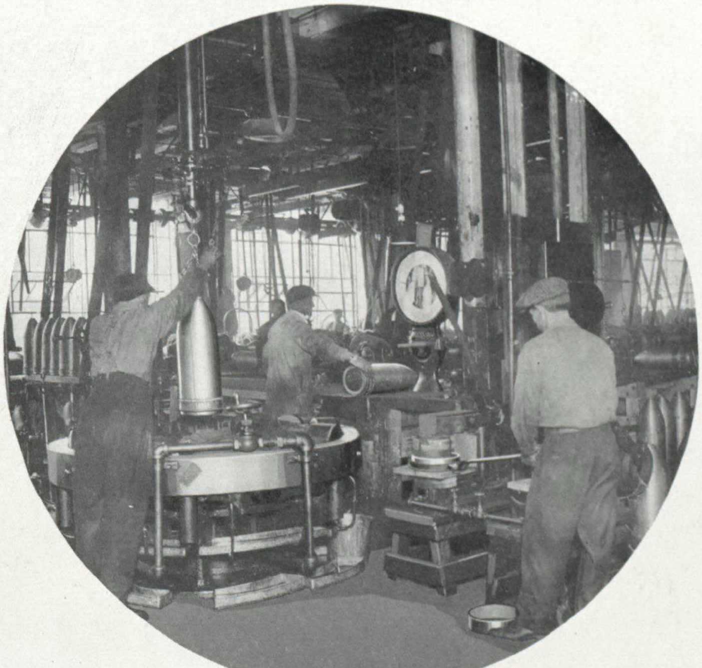


PRELIMINARY GOVERNMENT INSPECTION

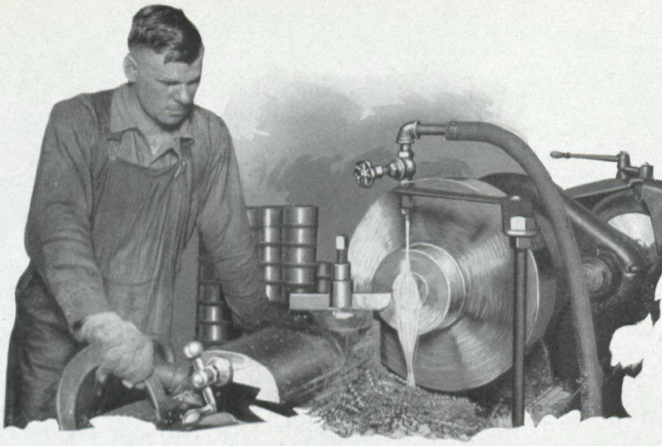
After the shell is grooved, the bore is polished to a glassy finish with emery. The shell is seated on a carriage and moved forward and back until the emery covered rotating arms have thoroughly polished every inch of surface (as shown on page 62).

The milling of the nose and adapter end is shown on page 61. The milling of the nose is shown in the general view, while the close-up is an excellent illustration of the operations on the base end. In both instances the shell is held in a slowly revolving chuck while the cutting tool mills the thread.

At this point in the manufacture the shell is subjected to a preliminary 100% government inspection, as shown above. Every dimension is gauged for a "go" and "no go," and the shell is given a thorough visional inspection.



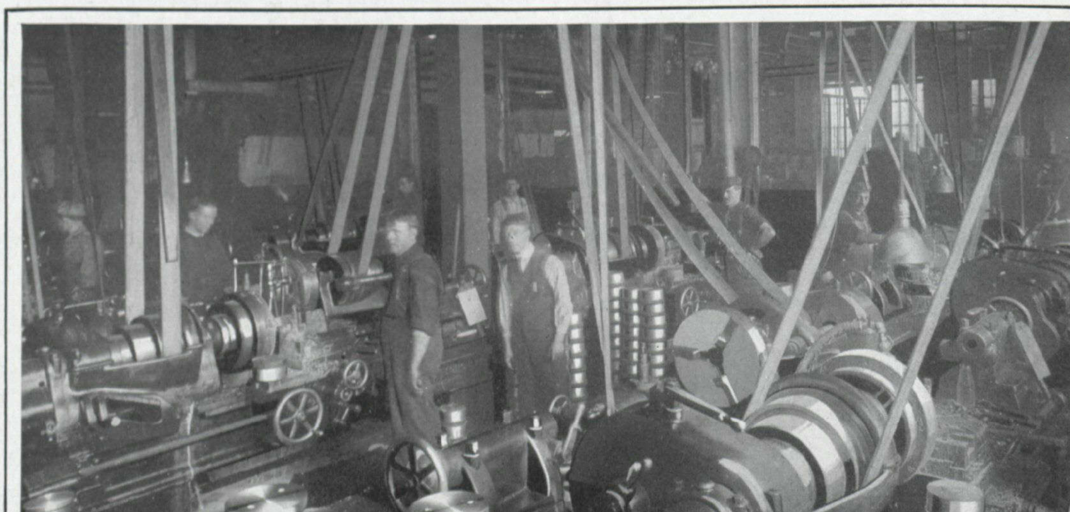
APPLYING COPPER BAND ON SHELL



ROUGH TURNING ADAPTER BODY

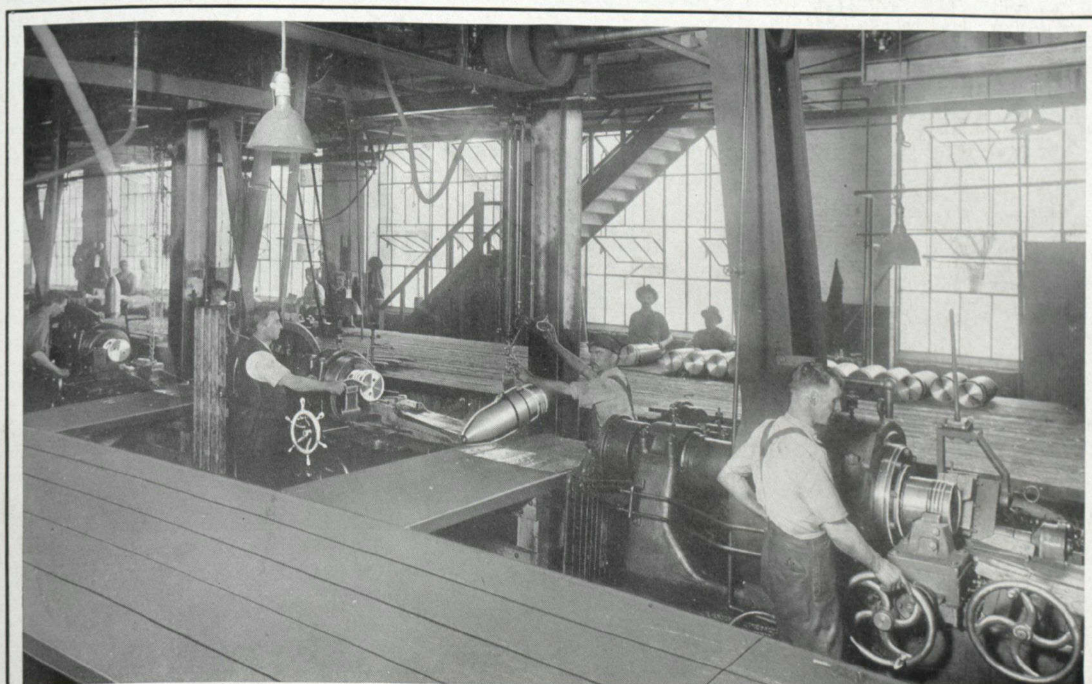
At this point the shells that are not passed are rejected on account of imperfections in the steel, or sent back for the correction of some minor defect. The shells that are accepted are next fitted with the copper rifling band (shown on page 63). The band is heated in electric heaters to an intense red heat and then pressed into the groove on a band press. The copper, softened by the intense heat, flows into the waves and undercut as the pressure is applied. When the copper band has been put on, the shell and adapter are assembled. The manufacturing processes on the adapter follow in a way those of the shell itself. The first is roughing the forging to shape and to size. Following this the wrench holes are drilled, which are used in screwing the adapter into the shell (illustration shown on page 66). The threading operation follows, a thread being cut to correspond to that cut in the base of the shell (illustration shown on page 66).

The shell and adapter are assembled by hand, as this method has been found to give better results than the machinery formerly used. In the process following, the adapter and end of the shell are faced, the adapter being rivetted to the shell while

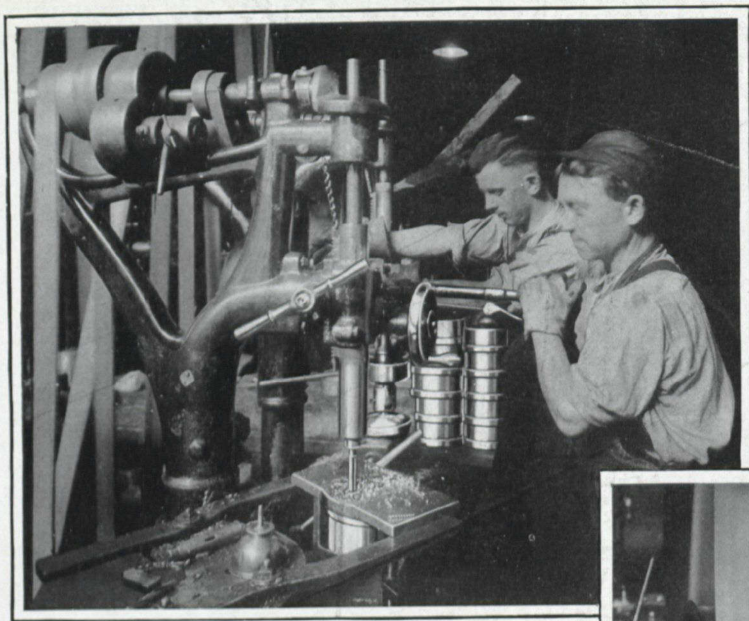


GENERAL VIEW MACHINING ADAPTERS

SHELL BAKING OVENS



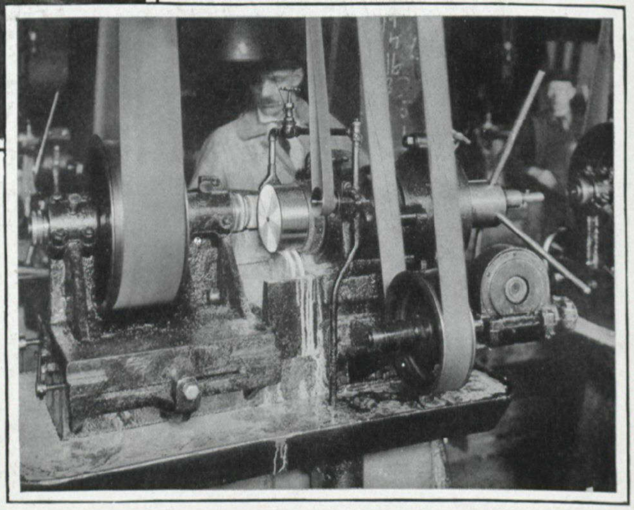
GENERAL VIEW BAND TURNING DEPARTMENT



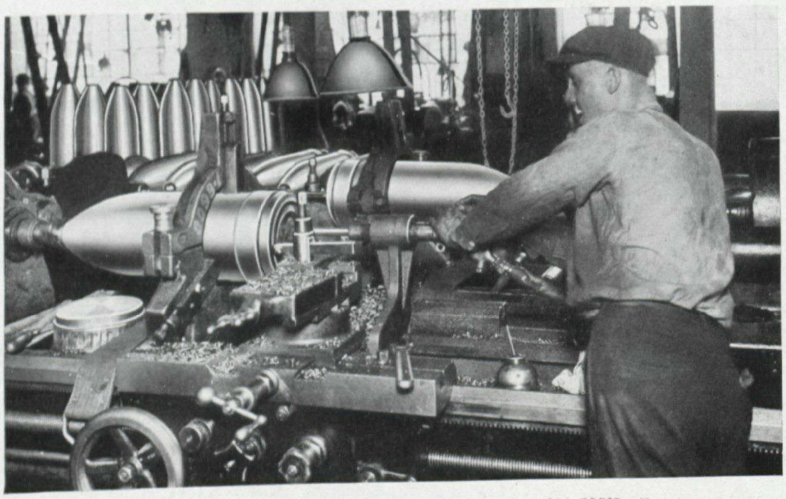
DRILLING WRENCH HOLES IN ADAPTER

the facing is going on (illustration shown below). The results of this process are such as not only to machine an absolutely smooth surface finish but to produce a job so complete that it is scarcely possible to detect the line where the adapter and the shell come together.

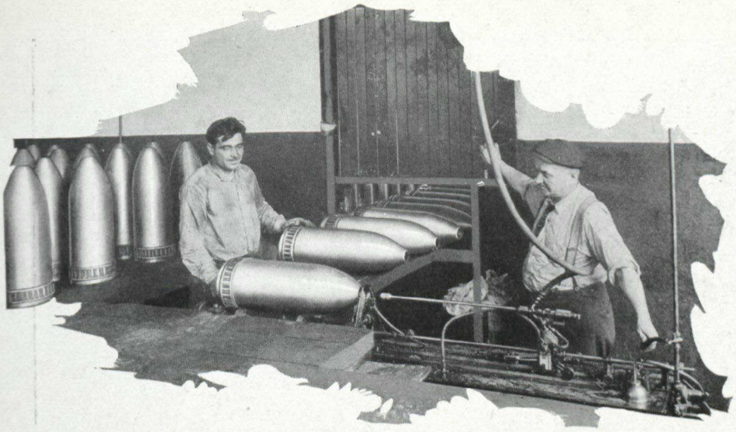
As complete as was the finish turning of the bore of the shell, which as you will remember, was ground with emery, still another process is used before this surface can come up to the requirements of modern munitioning. The illustration on page 67 shows the ingenious atomizing arrangement that varnishes the inside of the shell. The shell is slowly revolved on castors while the atomizer, sending a thin, even spray of varnish in all directions, moves slowly back and forth. The varnished shells are then rolled into the baking ovens on a car (as shown in illustration on page 65) and the varnish is baked for three hours. The final manufacturing operation on the shell is the turning of the copper band as shown on pages 65 and 67. The band is turned to extend .14 inch beyond the surface of the shell, thus giving the shell an outside diameter larger than the bore of the gun measured



MILLING THREADS ON ADAPTER



FACING END AND RIVETTING BASE OF PLUG

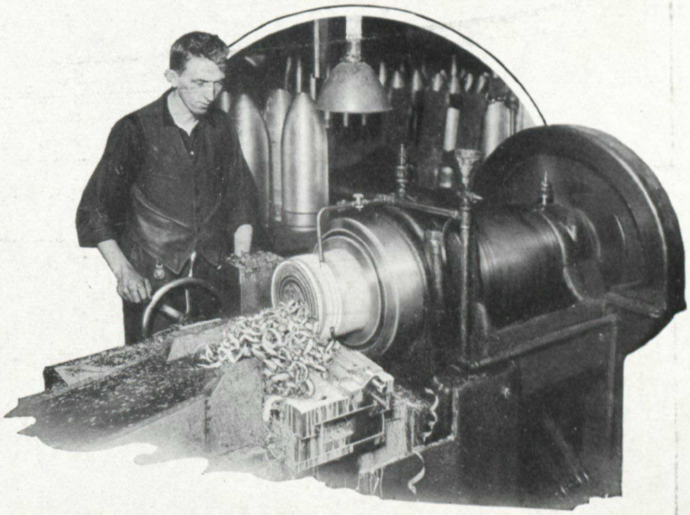


VARNISHING INSIDE OF SHELL

from the face of the rifling. When the shell is fired the soft copper is forced into the grooves of the rifling and imparts the rotary motion to the shell.

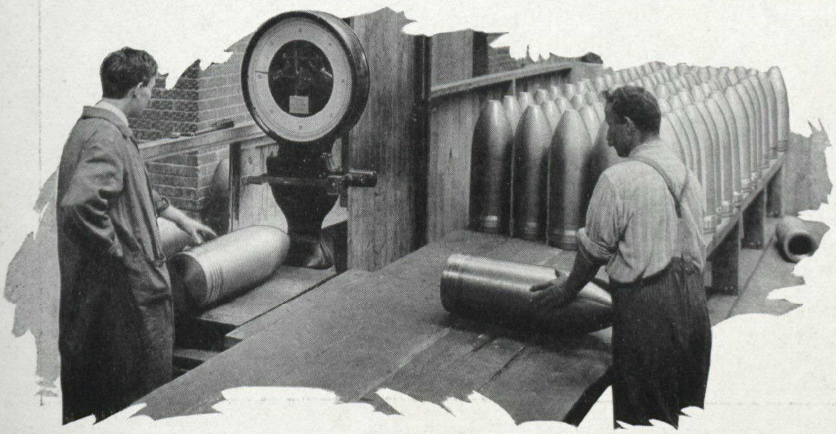
The weight of the shell is of the utmost importance in the calculations of the artillerist, and the Governmental regulations regarding weights are very strict. This inspector weighs every shell made, and requires that each shell weigh more than two hundred and forty-nine pounds twelve ounces, and no more than two hundred and fifty-three pounds twelve ounces.

After finally being inspected and approved, the shells are held in bond until time for their crating and shipment (as shown on page 68). On each of these shells are put marks telling its complete history, with information concerning weight, hardness and quality of steel and other things indispensable at the loading plant and for the calculations in artillery fire.



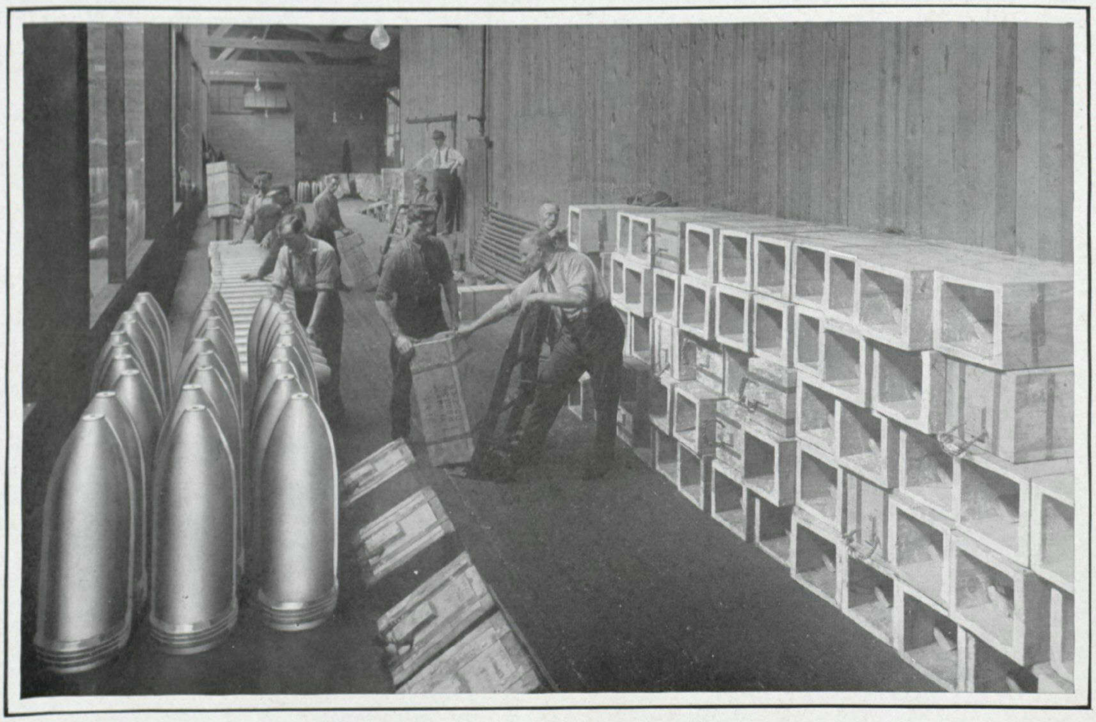
CLOSE-UP VIEW TURNING COPPER BAND

The manufacture of crates suitable and durable enough to carry the 9.2 on its journey across the Atlantic and then to the depot at the front is a separate industry in itself. Only the best made crates could possibly stand the trip. (Illustration of boxing and shipping is shown on page 68).



GOVERNMENT INSPECTING SHELLS FOR WEIGHT

GOVERNMENT BOND ROOM—SHOWING SHELLS AWAITING SHIPMENT



BOXING AND SHIPPING SHELLS

FACTORY MANAGERS AND SUPERINTENDENTS

THE TOOL ROOM

VISIT almost any factory. Someone will take you around and explain carefully and enthusiastically all the processes—from the floor where the rough machining is done to the shipping room where a small lampblacked youth—who once was a blonde perhaps—is stencilling addresses on packing boxes. As you are going out you will notice a long room filled with men and machinery that you haven't visited. The men look a bit older and more experienced than the others you have seen, and the machinery is of all sorts and descriptions. Curiosity

GENERAL VIEW TOOL ROOM

aroused, you ask about it. "In there? O ! that's the Tool Room. They make tools there." They didn't do that in the Company's plant. Maybe because my guide was a pretty well informed person and was not afraid of my asking questions he couldn't answer, but mainly because the Company's Tool Room has a reputation for being one of the best on the American Continent.

The work that this shop has done has been of the first importance in the success of the Company. To their original designs, both of tools and of special machinery, can be credited much of the volume now being turned out. Many of the tools and jigs which have proved so practical, and so much quicker and easier to run than the older types, were designed by these men who spend most of their day under a shower of sparks that spring to life when the emery wheel grits its teeth and tackles a slab of high speed steel—men are employed in this shop, the majority of them mechanics of the highest skill.

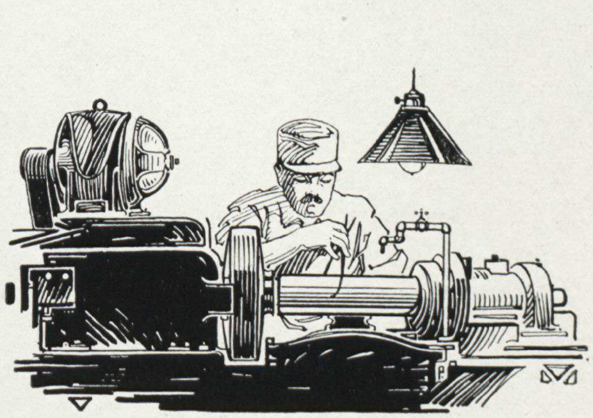
Records of Tools and Gauges

Of no less interest than the manufacture of tools are the records kept of the hundreds of them, and of the hundreds of gauges that are used in the inspection processes. Even gauges will wear, and even though it is a wear that is scarcely to be detected by the most delicate of measuring methods, the space of one ten-thousandth part of an inch to a manufacturer of fuzes and shells is a fact as real and important as a thousand miles. A miss is as bad as a mile in very fact—and worse—and a thousandth of an inch may well mean a miss—a failure to explode—the minor item of hundreds of dollars worth of steel, brass, explosive and time, the major fact of our brave Canadians left out on the field—and done for the benefit of the Hun.

It is no small task to maintain the correctness of each gauge—for there are no less than 285 of them used in the inspection of the small No. 80 fuze alone.

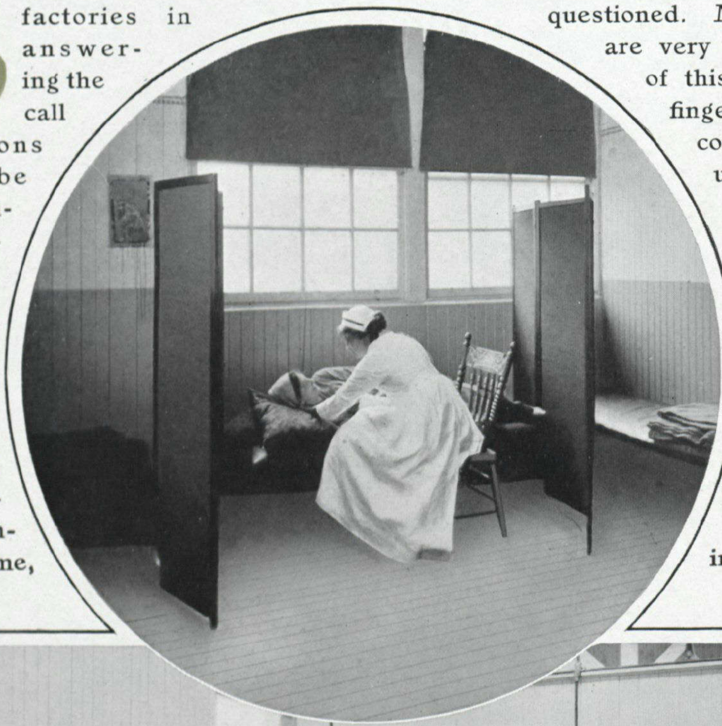
And, as you watch the hundreds of manufacturing processes carried out on the lathes and drills, and realize that a great number of these are special processes devised by Russell experts to speed production and reduce costs, it will occur to you that the records kept of tools are a record of another achievement. These tools are an achievement. The men who turn them out are more than mechanics. To conceive them means to conceive the whole great job. To produce them demands a degree of vision and practical imagination that is found not everywhere, nor every day. They have saved, literally, hundreds of thousands of dollars. They have added hundreds of thousands of finished fuzes to the production record. And the men who conceived them, designed them and produced them did it in almost no time at all, for there was no time.

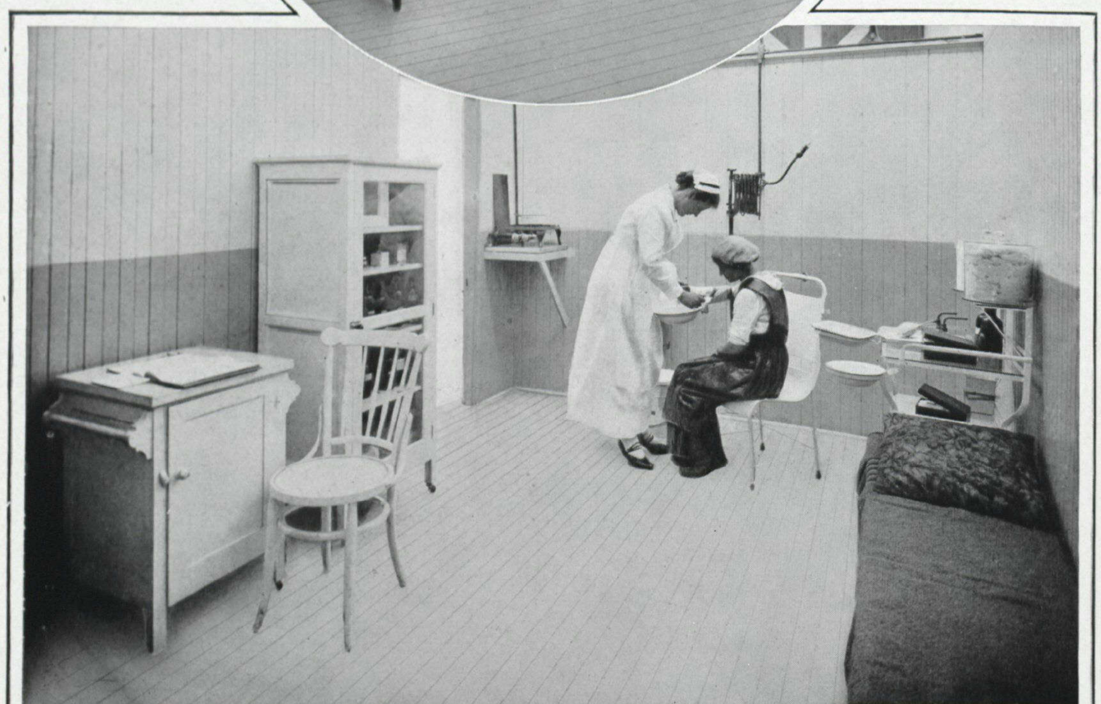
It was as big a job as any the Company was up against, this problem of new designs, and its rapid and successful solution adds as much credit to the Second Line of Offence as any other thing done since the work began.



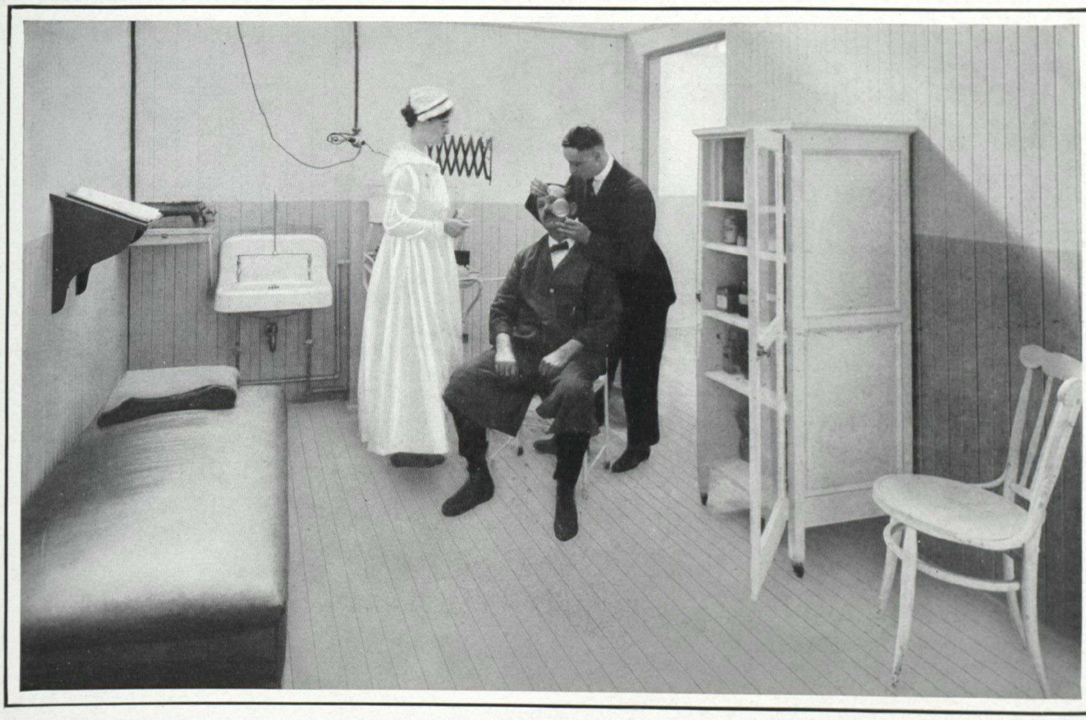
BEHIND *the* LINES

THE story of the Aladdin growth of the Company's factories in answering the call for munitions would not be complete without describing the company hospital. With the life of a munition plant necessarily limited and facing the possibility of termination at any time, the practicability of an extensive investment in welfare work might well be questioned. Major accidents are very rare in work of this type—bruised fingers and minor contusions make up the vast majority of cases entered on the books in the HeadNurse's office. Until a few months ago neither the Government nor any official body interested in the





WOMEN'S FIRST AID AND LOUNGE ROOM



MEN'S FIRST AID ROOM

manufacture of munitions had considered it necessary to make any regulation covering the care of workers.

In spite of this, a definite policy providing for injuries, sickness, and for looking after both the physical and mental condition of all employees, was adopted by the Company at the very beginning of their work.

There are two large rest rooms, each equipped with couches, and the girls are at liberty to use them when they are so inclined. Two trained nurses are in attendance at all times, and two doctors who have specialized in the type of accidents that characterize munitions manufacture visit the plant three times a day, and may be secured at a moment's notice.

The hospital records about 5,000 treatments per month—but this figure is much larger than it seems, for it includes single cases that are recorded on the books from two to twenty-five times—depending on the seriousness of the accident. The hospital staff does not confine its attention to accidents happening within the shop. Its purpose is the maintenance as far as possible of the highest standard of physical well being among the employees. The purpose of the rest room and the canteen is similar. It is the Company's theory, and facts have proved it to be true, that factory efficiency varies directly with not only the physical, but the mental condition of those who are doing the work. And that is why any employee may go and eat when she gets hungry or get rest and recreation when she is tired. Neither a hungry person nor a tired person is an efficient worker. A ten minute rest when you are fagged; rolls and coffee when you are thinking more of feeding yourself than your machine, will help you to do more than sixty minutes work in the next fifty.

SPEAKING of MUNITIONS

THE WOMEN'S LUNCH ROOM—PLANT No. 3

THERE are lunch rooms for both men and women—open night and day. To the credit of those who are in charge, they are indeed spick and span models that the average public restaurant could emulate to its everlasting advantage. By an arrangement the Company has an outside caterer serve the lunch room. They give them space, light, heat, etc., free of charge, in order that the employees may be charged a very nominal amount for the food. The tables and counters are of marble, and most sanitary and attractive in appearance. About 4,000 people are fed here each day.

Each woman has an individual sanitary locker space. By an ingenious arrangement of these the incoming and outgoing shifts do not interfere with each other in any way.

WAR SAVINGS CERTIFICATES

THE workers of the Russell plants have, in another and in a very substantial way, shown the genuineness of their interest in their country's welfare. They have not only given their time and their labor that the forces of Democracy may be firmly and forever established, but they have given their earnings. And it must be said that the very generous and freely given assistance of the Company in organizing the complicated and expensive installment system of War Savings Certificate purchase, has been an important factor in the large number of Certificates taken up. There are two systems of installment buying, one extending the payment over a period of five pay days, and the other over seven. In order to stimulate and maintain an active interest in the Certificates, the factories have organized themselves into

WAR SAVINGS CERTIFICATES

teams—each team representing a floor. A trophy is awarded at the end of each month and stays in the possession of the floor with the highest amount invested until that record is beaten by some other floor.

The clerical expenses and those of keeping the records are all financed by the Company. The habit of Certificate buying is increasingly popular, and as much as $100,000 has been subscribed for. With the staff reduced to 500, $80,000 in Victory Loan Bonds were subscribed for in less than one week, an average of $160.00 per employee. There are a large number of workers whose patriotism, combined with far-sighted common sense, has been the means of their investing hundreds of dollars in the loan—an amount which in the years to come will prove of substantial assistance in very many ways. Cases where generous earnings of the war years are wasted are not unknown, but they are very few compared with the general attitude of saving and investing.

A GROUP OF WILLING SUBSCRIBERS TO WAR SAVINGS CERTIFICATES AND VICTORY BONDS

A LETTER THAT IS PRIZED

IMPERIAL MUNITIONS BOARD
OTTAWA
OFFICE OF THE CHAIRMAN

October Fifth,
Nineteen Seventeen.

Dear Mr. Harris:

I desire to express on behalf of the Imperial Munitions Board, our appreciation of the manner in which you have filled your contracts for the production of time and graze fuzes. I am particularly gratified with the reports which we have received from London as to the high percentage of the fuzes which have been found up to standard.

I am sure these excellent results and the deliveries in contract period could only have been secured through the co-operation of the large force of men and women who have so efficiently served you during the progress of these contracts.

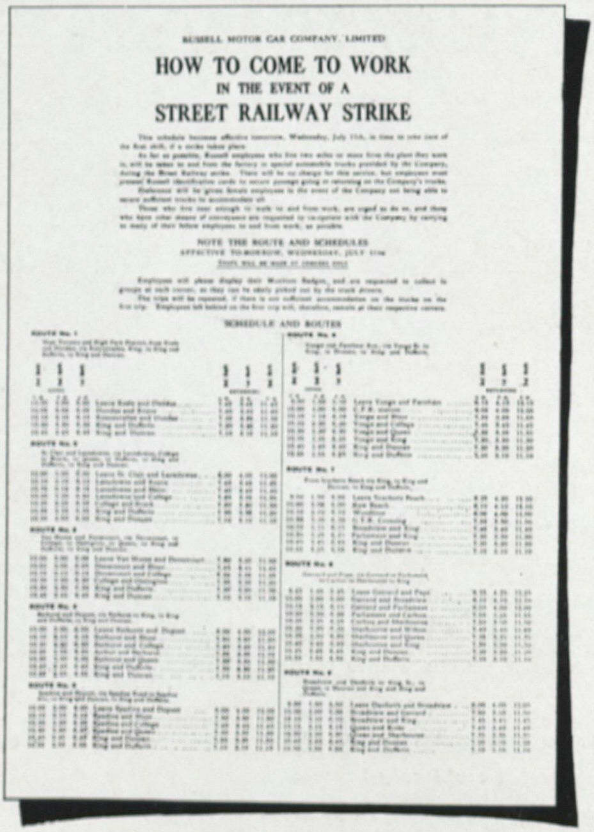
May I ask you to convey to the members of your staff, and the workmen and workwomen, this expression of our appreciation of what has been done.

Faithfully yours,

Chairman.

Lloyd Harris, Esq.,
President, Russell Motor Car Co., Ltd.,
TORONTO.

MEETING an EMERGENCY


RUSSELL MOTOR CAR COMPANY, LIMITED

HOW TO COME TO WORK
IN THE EVENT OF A
STREET RAILWAY STRIKE

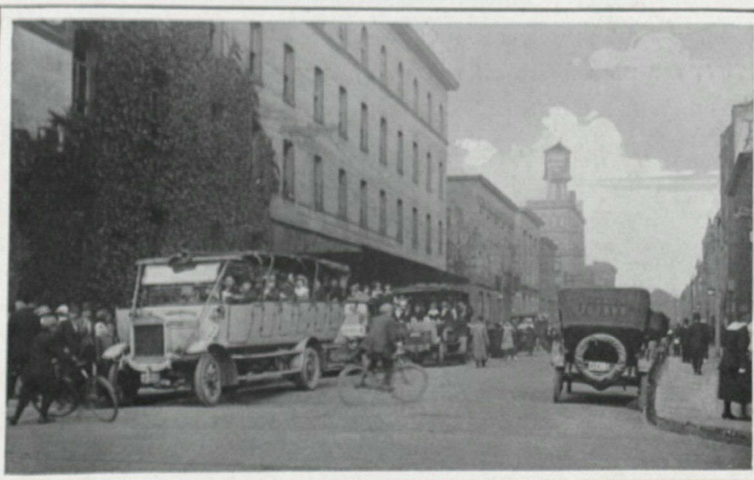
NOTE THE ROUTE AND SCHEDULES

SCHEDULE AND ROUTES

EMPLOYEES' MOTOR SCHEDULE

THIS page graphically emphasizes the wisdom of preparedness. When, in July, 1917, the threat of a street railway strike hung over the city, the Company took the steps necessary to ensure the minimum of delay in the production of munitions. The schedule here shown was drawn up and distributed to the employees, and in the subsequent dislocation of transportation facilities, it proved invaluable in

LEAVING DUFFERIN STREET PLANT

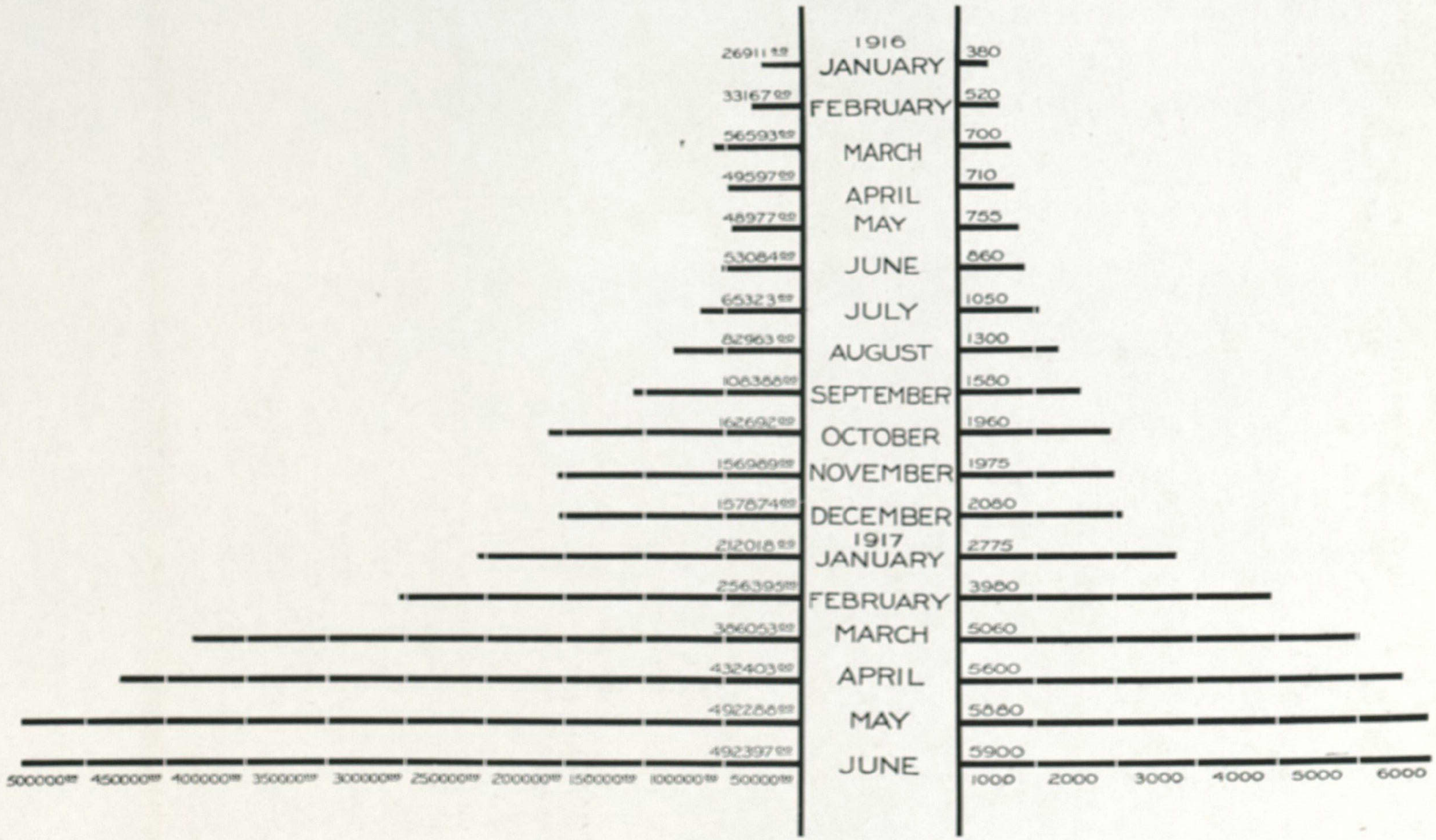


MOTOR BUSSES CONVEYING EMPLOYEES HOME FROM KING AND DUNCAN STREETS PLANT

enabling our workers to reach their employment without loss of time or energy. Motor busses and trucks were called into action to convey the employees from and to the nearest corner to their respective homes, and not only did this prevent any serious interruption in the output of munitions, but it demonstrated the interest of the Company in the individual as well as the national welfare.

MONTHLY WAGES PAID FOR
EIGHTEEN MONTHS

NUMBER OF EMPLOYEES FOR
EIGHTEEN MONTHS



THESE FIGURES DO NOT INCLUDE OFFICE STAFF AND FACTORY EXECUTIVES.

INTERESTING FACTS

Seven hundred and five miles of material (sufficient to cover a straight line from Toronto to Chicago) made **4,500,000 Graze Fuzes.** Bar steel accounted for 2,287,209 feet and brass rod for 1,437,125 feet.

The steel weighed 18,903,570 lbs. and the brass 519,880 lbs.

Eight million Time and Graze Fuzes kept our workers busy for **570 days.** The production sheets showed:—

3,450,000 Time Fuzes in 457 days.
4,500,000 Graze Fuzes in 554 days.
185,000 Shells in 559 days.

The total fuze production required 18,903,570 lbs. of steel and 12,358,480 lbs. of brass.

The making of 3,450,000 Time Fuzes used up 5,919 tons of brass.

Production in Graze Fuzes reached 650,000 in June—that is, 21,600 a day—15 a minute—or **one every four seconds.**

Women labour performed 70 per cent. of the work on fuzes.

Place the shells made by the Russell organization end to end, and they represent 50 miles of effective restraint on German militarism.

Two battleships, type of H.M.S. Hercules (20,000 tons) and H.M.S. Invincible (18,750 tons) could be constructed from the steel used in the production of shells and fuzes by the Russell organization.

Russell munitions plants employed 2,942 males and 3,016 females—in all, 5,958—during the period of maximum production. Foremen and superintendents are not included in these figures.

The execution of the work called for 256,052 square feet of floor space—nearly six acres.

The Company's Cafeteria at the Graze Fuze Plant served 4,000 meals a day during the period of maximum production.

The Company's pay-roll was the largest reported to the Ontario Workmen's Compensation Board during 1917. It amounted to over $3,500,000 for the year.

War Savings Certificates to the extent of $100,000 were sold to Russell employees.

Five hundred of the Russell staff invested $80,000 in Victory Bonds, averaging $160 from each employee.

Honor Roll

of the Employees Russell Motor Car Co. Limited and Canada Cycle & Motor Co. Limited

- W. Aiton.
- P. Amarando.
- W. R. Arnold.
- F. Aylott.
- W. Baggsley.
- S. Bailey.
- A. Barber. Lce-Cpl.
- F. Barber.
- J. Barber.
- S. Barber.
- J. Barton.
- J. Bavington.
- J. H. Bellis.
- R. Blake.
- C. G. Boorman. Lce-Cpl.
- F. W. Booth.
- ✚ A. Boustead.
- J. Brady.
- A. Brandon.
- M. Breakwell.
- ○ T. Bromley.
- G. H. Brown.
- E. Burchard. Captain.
- N. Byfield.
- C. Chappell.
- ✚ W. Chappell.
- W. S. Clayton.
- E. Clark.
- ✚ H. Collett.
- F. Cooke.
- G. Cooper.
- H. Cooper.
- R. Cooper.
- F. Crole.
- J. Cross.
- A. Day.
- G. Deacoff.
- J. Dean.
- P. Dean.
- H. Doe.
- △ J. M. Dooling.
- M. Dowle.
- A. M. Dunstan. Cadet
- J. Duffy.
- T. Duffy.
- A. E. J. Dunk.
- E. E. Dunk.
- W. Elliott.
- L. Elvin.
- F. Fawcett.
- J. A. Flatt.
- W. Ford.
- E. Foster.
- W. Fox.
- A. France.
- ✚ L. France.
- S. Fret.
- J. Gander.
- G. H. T. Gandy.
- T. Gandy.
- A. Gardiner.
- R. Gardiner.
- E. Garrioch.
- E. Gibbs.
- F. Goddard.
- G. Gordon.
- F. Gorrie.
- W. Grabham.
- H. Grahim.
- J. Graham.
- T. Gregory.
- A. E. Hadaway.
- ✚ G. Haines.
- P. A. R. Hall.
- ✚ A. Hardacre.
- T. Harding.
- L. Haslam.
- S. Hasselfeldt.
- ✚ R. Hay.
- T. Henderson.
- W. Herron. Lce-Cpl.
- A. Hill.
- J. Hill.
- J. Hobson.
- P. Holbron.
- H. Holmshaw.
- ○ T. Hubbard.
- J. Hughes.
- T. A. Hughes.
- W. G. Hughes.
- △ A. Hurst.
- H. Hutchinson. Cpl.
- J. F. Ineson.
- W. Inwood.
- F. Jackson.
- F. Jamieson.
- ✚ G. Jemmett.
- L. Jennett.
- H. Johnston.
- E. Jones.
- W. Keans.
- ✚ W. H. Knight.
- N. Leach.
- R. Lennox.
- W. Lindforth.
- B. W. Livingstone. Sgt.
- G. A. Lodge.
- F. L. Lozo.
- C. Lundy.
- H. T. MacKay.
- H. Mackie.
- F. Manser.
- H. Manser.
- ✚ R. Mantell.
- B. Marsh.
- C. Marsh.
- F. Marsh.
- R. H. Marsh.
- W. B. Marsh.
- B. Marshall.
- E. May.
- H. McCullough.
- B. McDonald.
- E. McDonald.
- E. McKnight.
- W. C. McLachlan.
- R. McNellis.
- J. Metcalf.
- G. L. Moran.
- J. E. Munday.
- △ A. Murray.
- S. Murray.
- V. Murray.
- C. Nash.
- H. Newman.
- ✚ W. Newton.
- A. G. Nichol.
- H. Nuttall. Lce-Cpl.
- W. Oakley.
- P. Ofreddi.
- R. Ofreddi.
- T. Orrell.
- B. Palmer. Sgt.
- W. Paton.
- ✚ R. Pearce.
- W. Pennell.
- G. Pitcher.
- F. Pounsett.
- J. Reeves.
- T. Reid.
- A. Richardson.
- A. Riddiford.
- L. Ridout.
- J. Robson.
- G. Rose.
- P. Rowe.
- P. Rubicine.
- T. Sargeant.
- W. Savage.
- △ D. Schofield.
- T. Smedley.
- D. Smith.
- P. Snare.
- E. Southorn.
- ✚ N. Southorn.
- J. Speakman. Sgt-Mjr.
- A. Stacey. Cpl.
- D. Still.
- J. Swanton.
- B. Taylor.
- F. Taylor.
- ✚ H. Taylor.
- J. Thompson.
- A. L. Tuckey. Sgt.
- Wm Turner.
- A. Wainwright.
- A. J. Wanstall.
- H. Watts.
- V. Wellwood.
- H. Westphall.
- G. Whitehead.
- ✚ J. Wiltshire.
- C. Wright.

Winnipeg Branch

- ✚ F. W. Bridgman.
- △ F. J. Chalmers.
- A. W. Charles.
- F. D. Chisholm.
- F. Findlay.
- J. Leckie.
- L. D. Ridham.
- Dan. Slavin.
- Thos. Walker.
- H. J. Wildman.
- G. H. Williams.

Vancouver Branch

- J. Graham.
- J. Moore.

✚ Killed. △ Wounded. ○ Prisoner.

LATER DEVELOPMENTS

OWING to the unexpected curtailment of munition work in Canada in August last, several changes have been made in the Russell organization since the compilation of this book was started.

For instance, the equipment previously used for making the 9.2″ shell is now turning out 6-inch shells.

With a large quantity of valuable machinery idle on its hands, the Company sought and found an opening for the use of a substantial portion of this equipment, by securing a contract for anti-aircraft gun mounts from the Department of the Navy of the United States.

For the execution of this contract a plant was purchased at 93 Dewey Avenue, Buffalo, N.Y., the Company thus extending its sphere of wartime usefulness in co-operation with our Allies across the border.

The undertaking of this important contract in the United States necessitated several changes in the personnel of the Company's organization.

A Company known as Russell Motor Car Company, Incorporated, was organized in the United States, and Mr. C. R. Burt resigned his position as Assistant General Manager of the Canadian Company to become General Manager of the United States Company. Mr. H. D. Scully was appointed Assistant General Manager of the Canadian Company in Mr. Burt's place, and Mr. J. W. Widdup became Secretary in place of Mr. Scully. In addition several members of the Company's factory organization were transferred to the United States Company, which has now commenced operations.

The Company has closed Plants Nos. 1 and 4, and moved its Head Office to Plant No. 2, at the Corner of King and Dufferin Streets, Toronto.

While the Company's chief work at present is the carrying out of the 6-inch shell contract, it is again entering the commercial field, in which it is finding a market for screw machine products and other metal articles for which its equipment is suitable.

BUFFALO PLANT OF RUSSELL MOTOR CAR CO.

RUSSELL MOTOR CAR COMPANY, LIMITED

HEAD OFFICE

Corner of Dufferin and King Street West, Toronto, Canada

OFFICERS, 1917

President - - - - - - -	LLOYD HARRIS
Vice-President and General Manager -	T. A. RUSSELL
Assistant General Manager - -	C. R. BURT
Secretary - - - - - - -	H. D. SCULLY

DIRECTORS

A. E. AMES
C. R. BURT
LLOYD HARRIS
T. A. RUSSELL
E. B. RYCKMAN
H. D. SCULLY
J. N. SHENSTONE

OPERATING MUNITIONS FACTORIES AS FOLLOWS:

PLANT NO. 1—Brock Building, Corner of King Street West and Duncan Street, Toronto.

PLANT NO. 2—Ormsby Building, King Street West and Dufferin Street, Toronto.

PLANT NO. 3—Corner of Dufferin and Liberty Streets, Toronto.

PLANT NO. 4—Purman Building, 265 Adelaide Street West, Toronto.

AFFILIATED COMPANIES:

CANADA CYCLE & MOTOR CO., LIMITED, Weston, Ontario.
Manufacturers of Bicycles, Skates and Bicycle Accessories.
Branches at Montreal, Winnipeg and Vancouver.

MACHINE AND STAMPING COMPANY, LIMITED, TORONTO, ONTARIO.

THE MOTOR CAR INDUSTRY

The Company sold its Motor Car business to Willys-Overland Limited, in October, 1915, taking payment in shares in the latter Company, in which it has a substantial interest.

RUSSELL MOTOR CAR CO., INC., 93 Dewey Ave., Buffalo, N.Y.

President - - -	LLOYD HARRIS
Vice-President - -	T. A. RUSSELL
General Manager - -	C. R. BURT
Treasurer - - -	H. D. SCULLY

DIRECTORS

C. R. BURT
LLOYD HARRIS
B. A. LINDERMAN
T. A. RUSSELL
E. B. RYCKMAN

Official Munition Workers' Service Badge, issued by the Imperial Munitions Board. A new bar is added for each six months' service. Some of the Company's workers now boast of four bars.

The Company's Identification Badge for Employees.

Written, Designed and Produced by
Southam Press, Limited,
Toronto and Montreal