Women's Employment in Artillery Ammunition Plants, 1942

By

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INTRODUCTION

Earlier survey.

In the spring of 1942 agents of the Women's Bureau visited two Government arsenals to study the occupations involved in the making of artillery ammunition. Processes used in the manufacture of metal components, propellant, and cartridge cases were studied, as well as those that are necessary in the assembling and loading of parts and complete rounds of artillery ammunition. Powder-plant making and loading and the manufacture of certain types of powder cases were included in the survey.

Following these visits, descriptions of the operations in which women were engaged, and suggestions concerning operations being performed by men on which women could be used, were published in a bulletin entitled “Employment of Women in the Manufacture of Artillery Ammunition.” While women were found to perform in departments in which small parts were being assembled and inspected, it was evident that they could be used more extensively on various machine operations where small parts are involved. In the making of certain additional kinds of cases, on operations requiring the handling of a large number of cases, or in the preparation of certain materials, women are not employed extensively because of the size and weight of many of these objects. Therefore, it was felt that women’s work could be expanded mainly on the smaller shells and cases, such as those of the 37-mm. or 75-mm. class.

Scope of recent survey.

With the development of the defense program, and the rapid progress made by the two arsenals that were visited, it was determined that the occupations in which women actually were being employed. In contrast to the two arsenals that were visited, however, none of these plants is engaged in any appreciable extent, or will be so engaged, in the manufacture of artillery ammunition or other metal parts. Therefore, the occupations considered in this survey included in the making and loading of powder bags, or in the assembling and loading of shells and cartridge cases, and of small parts such as fuses, boosters, primers, and detonators. One or two of the plants indicated in the survey
were making a somewhat wider variety of products, but occupations not directly related to artillery ammunition have been excluded from this report.

A representative group of plants, including several magazine-type establishments, was visited. Practically all these new plants were located in the northern, northeastern, and middle-western parts of the United States. Most of them were owned by the government but operated privately, while a few were new or partly expanded government plants. The new plants had been under operation for a variable period of time, some for a number of years only partially, at the time of visit. The others were expected to begin production soon.

Number of women.

Estimates as to the number of women these plants expected to employ at peak production were obtained from plant and government officials, but such estimates were subject to change with changes in circumstances, in production methods, or in other factors. Though the estimates given at the time of visit proved to be too high in some instances, in others it is possible that they may be revised upward, especially as these plants were visited prior to December 1 or very shortly thereafter. Officials of a number of companies indicated that they expected the proportion of women employees to be a high proportion of the total. In one case, officials estimated that 80 to 90 percent of the employees would be women; in another it was estimated that 60 to 70 percent of the total would be women; and in a third case, it was estimated that 50 to 60 percent of the total would be women. In most cases, the estimate of the proportion of women employed was based on the assumption that women would be employed in the labor force in the same proportion as they are employed in the labor force in general. However, on the basis of the best data available it seems evident that the proportion of women to be hired out of the total labor force in these plants depends largely on the size and type of the ammunition to be loaded. All the single-loading plants, for example, expect to use a high proportion of women, ranging from 60 to 70 percent. Officials of two plants designed primarily to assemble and load fuses, propellant, and other small parts expect that 20 to 30 percent of the employees will be women. In the multi-loading plants, the number of women who can be used will depend mainly on the size and weight of the shells and bombs being loaded. Of all the plants visited, two government depots probably will employ less than 20 percent women to their peak labor force. However, neither of these plants is designed to continue its operations beyond the loading and assembling of artillery ammunition. In the plants visited in this study, the proportions of women employees vary widely, from 20 to 80 percent, with a majority of them ranging from 40 to 70 percent. In general, the proportion of women employees will depend largely on the size and type of the ammunition to be loaded.
Women in Ammunition Plants, 1917

All these figures concerning women employees include office workers and a few other groups of women, negligible in numbers, such as nurses, a few clerks, stenographers, and secretaries, not employed in the operating and producing parts of the plants. However, the great majority of the women are employed, and will continue to be, in shop operations, that is, in the actual assembling, loading, inspecting, or packing of ammunition. At the time of visit there was a wide range in the proportion of women office workers to the total women employment at each plant, but from the estimate of anticipated employment it would seem that in most plants this group will comprise not more than 10 percent of the women labor force.

Other matters of inquiry.

It was apparent at the time the visits were made that there was variation from plant to plant in the types of work on which women were being employed; in several instances women were seen performing an operation in one plant that in another plant was being done solely by men. As this indicates that the employment of women can without doubt be extended to additional jobs in a good many plants, an effort has been made to describe all the chief types of shop or office operations on which women were engaged, so that the lists of women's work already published may be more complete. It is not possible, however, to compile a complete catalog of all the different steps in operations on which women were employed, and normally would be employed, and while some operation may have been omitted, it is believed that the principal types and varieties of jobs, and those most typical, have been included.

Since this report is designed as a supplement to the earlier bulletin of the Women's Bureau on the employment of women in artillery ammunition, no attempt is made to describe here, except in very general terms, the products customarily included in artillery ammunition. The emphasis is placed on the work actually being done by women.

It is recognized, of course, that there are hazards involved in working with explosives, and that these are serious in connection with many jobs in artillery ammunition plants. In addition to the danger from explosions, workers are subject to dangers from poisoning or infection in working with various toxic substances, such as nitroglycerin, sulfadiazine, carbon disulphide, etc. While women are not directly employed in this type of work, they may suffer also from developing skin infections from working with cleaning fluids, or even from handling metal parts. Attention was given, therefore, to general working conditions and to provisions for safety in the plants visited, but no attempt was made to analyze thoroughly the health hazards involved in working with different kinds of powder and chemicals, a highly technical subject that for a long time has been a matter of study by Government experts.

In addition to information concerning occupations, and general working conditions, statements were obtained from plant officials concerning the numbers of women employed, the requirements for hiring, wage systems, scheduled hours and shifts, training, and other personnel policies.
OCCUPATIONS

The occupations in which women were engaged in the making and assembling of components have been discussed separately from those in which they were working on lines where shells, depending on their size and type, were being loaded and assembled with cartridge cases, warheads, fuses, and other components and accessories. The various varieties of shells usually were being assembled with all other necessary parts to make complete rounds of ammunition ready for firing. There was a noticeable difference in the proportion of women employed on the various types of lines; on some, women were entirely absent, while on others they were employed on different types of loading lines. Some plants were handling both types of projectiles, but in others only components were being loaded and assembled, these to be shipped later to other plants to be combined with projectiles. Further, there seemed to be some tendency in the industry to differentiate between the two kinds of products, and the United States Army Ordnance Safety Manual states that "shells, primers, boosters, primer-detonators, and similar loaded components are a distinct class of ammunition when they are not assembled or packed with projectiles."14

Powder bags are essential ingredients of rounds of diffused and solid (separate loading) ammunition. Since the operating plants making and loading these bags were found to be highly specialized and devoted entirely to this kind of work, the occupations in which women were employed in these plants also have been considered separately.

Components.

Because of their dexterity and patience in working with very small parts, women are rather generally considered particularly adept at the operations required in the loading, assembling, inspecting, and packing of different types of components, such as primer tubes, primers, boosters, buffer cups, detonators, fuses, and the many various and sizes of these. In fact, so might have been predicted from the first Women's Bureau survey of the industry, a high proportion of the employees found in this general type of work were women. A number of lines engaged in such operations were visited, and in some instances two thirds or more of the employees were women.

However, it was not possible to visit all such lines in all plants, and in any case it would be impossible to describe all the operations in complete detail. Prevailing hazards of different kinds of small operations are necessary to complete all the many types and varieties of components produced. It is difficult to say how far the number and type of operations vary somewhat from plant to plant, though many operations are actually quite similar, differing from one another only slightly. It is possible, therefore, to describe the principal types of operations in general terms. Also, a number of examples, illustrative of the different kinds of work being done by women in the plants visited, have been included to indicate the nature of the operations performed.

Loading

In a broad sense the term "loading" can perhaps be considered as including all the operations essential to the assembling of components in their final form to make a complete round of ammunition. However, loading is here considered in a narrower sense as consisting primarily of the operations quite directly related to the filling with explosives of various small parts, such as percussion elements, delay elements, bursts, cups, and detonators.

Generally the plants included in this survey were confining their operations to the loading and assembling of ammunition and were not handling the explosives directly. These operations consisted mainly of blending initiators and other chemical substances to make certain types of powder. In one instance where manufactured powder was used, no women were doing this type of work.

In a number of plants, though, women were frequently handling the loading of components, including metal. Usually these were made of black powder or plastic and here again most of the operations were men. In one plant, however, women were operating the press machines to make black powder pellets, while men were doing the heavy work of handling the bulk powder. In each case a woman was assigned to each of the machines, and in each she was responsible for the operation of two presses.

In other plants, however, women were employed in making small parts. In the work quite a number of men also were employed. Lead oxide, fulminate of mercury, tetryl pellets, and primer mix, which is a combination of several chemical substances, were the types of powder being used most commonly by women in these loading operations. Some women were inserting tetryl or black powder pellets in containers.

This in itself is not difficult, though it is necessarily laborious and, in the case of tetryl particularly, there is danger of explosion or poisoning against which certain precautions are necessary.

Women were engaged also in loading percussion elements for primers. In one type of operation women were placing empty percussion caps in places for filling, and were then adding black powder over a brass plate perforated with holes through which powder was put into caps. A few women were employed in loading folding machines, which stamped out disks of black powder and pressed them into percussion caps. In another plant women were doing practically all the work in a setting-up department, elements being placed in order and pressed into caps. In another plant women were picking up very small paper disks and weighing them on a scale to be sure that only one was put at a time into the loading tool. The next woman in line was putting a drop of shellac in each priming cup and inserting a disk. After one or two other small operations, women were putting the wet primer mix in the caps. Then, after the cases had been placed over the caps, each one was inserted.
under a press. Women were operating the presses. The excess primer mix was then wiped off and the completed elements were placed in trays to dry.

Several lines were visited in which women were engaged in various operations which are necessary in the loading of detonators. They were weighing powder, generally lead amide or fulminate of mercury, and mixing the powder in a mixer. Sometimes more than one kind of powder was used in detonator loading and then the charge was consolidated by means of a press. The pressed powder was loaded into detonators, which were then activated. Each operator behind a packing table worked behind a barricade consisting of a glass panel. However, in order to do the loading the operator ordinarily kept his head down behind the barricade. Throughout the plant, barriers were used to shield the women from exposure to the explosive dusts and fumes. No separate barriers were used for detonation work, but the barriers around the machine were placed at the entrance to the loading area where the women worked. Usually a number of men also were employed on these lines, sometimes in the most hazardous operations and sometimes to manipulate the presses requiring a fair amount of physical strength.

In the first survey made by the Women's Bureau's agent at two different times, it was found that many actually were employed to do the work of crimping the loaded detonators in press and of ejecting them from machines or dies used. However, in the plants visited more recently this was not uniformly true. Some women as well as men were operating presses on detonator lines. In one line visited, for example, women were operating all kinds of presses being used and a woman was operating the final or 'knock-off' machine that ejected the completed detonators.

Assembling and inspecting.

In connection with all loading operations, a number of women were employed in performing small assembly-line jobs, such as inserting clips in caps prior to loading or placing caps on loaded parts. Such jobs did not require the direct handling of explosives, but were being done in close proximity to loading operations. Some inspection also was being done along these lines.

Women at various lines, where various small parts, already loaded, were being assembled and assembled into complete components, some of these small finished parts for percussion elements or detonators, came from other parts of the plant. Women were being employed on virtually all the different kinds of operations at these lines. That is natural, because of the type of work required. For example, women were engaged in such jobs as the sorting of small parts, the insertion of disks, washers, springs, or wires into metal caps or containers, the turning together of different small parts, and the placing of tiny pieces in holes or depressions in parts of somewhat larger size. Also, women were employed in cleaning off excess paint in empty primer boxes. Some assembly work required the handling of Kent materials only, the other work entailed no explosives, but other work required parts already loaded. Women at the end of the assembling processes were engaged in such operations as applying rubber to seals or gum to shells in various parts of completed units, usually to make them watertight.
Women in Artillery Ammunition Plants, 1942

Many of the women employed in assembly work were performing all the necessary operations with their hands, though a few were using hand tools, such as screwdrivers, wrenches, or files. However, a good many women were operating various kinds of presses, particularly for crimping or staking operations. Some of these were manipulated by hand, others were operated by air pressure applied by foot pedals. Barrettes often were found around these presses. Some pneumatic screw drivers and power drills also were handled by women.

At many stages during the assembling, as well as in the loading of fuses, primers, or other components, inspections are made. The size, shape, and condition of each part must be checked, and the part must be found to function properly and at the right time. Parts received from other plants are inspected at the beginning of operation. Sometimes completely assembled fuses, except that they are unlabeled, are received from other plants, and these must be disassembled as well as inspected.

Women were doing practically all preliminary inspection and a great deal of other visual inspection in looking for surface defects. In a few instances magnifying glasses were being used. Women were using micrometers and various types of gauges to check the dimensions, as well as scales to check the weight, of parts and completed assemblies. In two plants women were testing primer holes for holes by sitting in a completely darkened room and looking at tiny holes over a small electric light bulb. In many cases, testing machines also were being operated by women. By the use of such a machine it is possible, for example, to test a fuse to see whether it will operate when it is to fire. Naturally, there was considerable variation in the exact sequence of operations, and inspecting all the many different types of fuses, primers, and other components, but a few examples of operations are: may be mentioned.

1. At one plant where a delay-action type of point detonating fuse was being assembled, women were engaged in putting into the plunger body a delay (a small aluminum cylinder filled with lead azide), a delay (a pellet of compressed black powder), a delay wad, a primer, and a primer cover. On this particular line each woman inserted all these parts in the plunger that she assembled. In the next operation a centrifugal fuse and springs were inserted. Then women assembled the firing pin, containing a plunger support and a plunger retaining spring. In a later operation the lock pin was inserted and crimped into place by use of a press.

On this same line another series of operations was being performed by women assembling the fuse heads. The metal heads were inspected for defects and gaged to be sure that they would fit properly with the firing pin. Detonators and detonator shields also were then inserted in the heads and a retaining clip was put on with a pneumatic screw driver.

In another plant, another line, the operation of inserting the primer tube was being carried out. The women here assembled the primer tube, placed it into the body of the fuse, and then the primer was inserted into the head of the fuse. After the primer was inserted, the fuse was then ready and was finished.

In the meantime the primers were made ready, and the percussion cap was put onto the primer and the fuse was then ready for testing.
Similar types of operations were carried on by women on other lines where breeches were being assembled. Women were placing inserts in booster bodies by the use of tweezers. Onion-size disks were being placed over the outer axes by women. Some women were serrating the caps containing trinitrotoluene to the booster bodies by hand. Others were tightening these caps to the bodies with wrenches, and then the caps were sealed to the bodies. The completed units were passed under an overhead gage and given a final inspection.

Packaging

At the end of all the assembly lines for components a number of women were engaged in packing operations. In some instances each completed fin was first placed in an individual cardboard container. Smaller parts were being packed in boxes and women were employed in taping these boxes and dipping them in wax to make them water-resistant. In other instances the components were unitized and held together with plastic bands. The completed packages were then packed in cardboard boxes. The boxes were either marked to indicate the kind of fuse, primer, or booster contained in a package, the lot number, and any other essential data on the containers. Usually final packing of components is done in boxes of fifty large lots, and are generally being done all this work, since it is too heavy for women.

Shell Loading and Complete Rounds

A number of the plants visited were engaged in loading shells with explosives and in assembling them with components and other parts. Shells of the 75-mm., or 3-inch, as well as smaller ones, usually being made into complete rounds of fixed or semiballistic ammunition ready for firing. The projectiles were being assembled with loaded cartridge cases, fuses, and other necessary parts; for example, windhills in the case of anti-aircraft shells. Proportions to be used in trench mortars were among the types being assembled and on these 4-inch shells were attached to the shells rather than cast components. The shells were then loaded with the appropriate fixed or semiballistic propellants.

In fixed (cannontype) ammunition, such as shells of the 155-mm. size, a similar propelling charge of powder bags and the fuse would be packed separately from the shell and the final assembling would be done at the time of firing. Generally, work on shells of these sizes appeared to be considered too heavy for women, and for the same reason women were not employed to any appreciable extent on those where bags were being handled. In this, with a few exceptions, women were employed generally on lines where shells of the 3-inch, and 60-mm. sizes were handled.

Partly because of the fact that different sizes of shells were being loaded in different plants, there was considerable variation from plant to plant in the type of work women were doing. But there was also variation in the occupations on which women were employed in plants loading some shells of very similar types.

In one plant, for example, women were engaged in scoping parts through TW steel tripods, weighing at check weighing and, and packing in boxes. In another, they were engaged in performing the same work with machines operated by men. In another, however, in which the size of shell was being loaded on one line, men were performing all these operations. The weighing and pouring of powder, which women were doing in the one plant, requires no special physical
strength but is hazardous, and precautions against infection from TVT are necessary. Precautions should be observed also, of course, when men are employed.

Actually women were employed to only a minor extent in the loading of shells. In addition to prime some powder TVT, women were performing a few small operations in several plants on shells being loaded with a tracer charge. The women were dropping follow-ins into the shells, usually on top of the powder charge, to form tracer and igniter charges, and some were placing calibration covers over the finished charges. Some women were operating presses to press down the powder in the shells, but men also were performing this part of the operation in some plants.

Women were being employed generally to load cartridge cases with propelling charges. Stick-type powder for fixed ammunition was being weighed and check weighed on turbines and scales. Women were doing this work and also pressing the powder into cartridge cases. In one plant it was noted that women were performing this entire operation in groups of three.

In shell-loading ammunition a number of plants were employing women to tie powder bags into cartridge cases. The first bag in a group was filled over a bath in the base of the cartridge case, and the other bags in the charge were then placed (in the case on top of this bag).

Women were performing a number of operations involved in the insertion of primers into the base of cartridge cases. After primers were used to press the primers evenly into the case, and women in some instances were opening these cases on the 20 mm. and 240 mm. cases. In one plant it was reported that women placed the primers in the cases. In other plants it was reported that the primers were placed in the cases by hand, the ends of the primers being cut off. This was done because the twisting of the primers into cartridge cases was not apparently the employment of women has been extended to this type of work recently.

Women were employed in several other miscellaneous occupations connected with the making of shells. Though practiced varied from plant to plant, women were employed in at least one plant, and sometimes in several, on each of the following operations:


to empty shells—Women were seen standing on an assembly line in a plant where men were doing this sort of work. They were using an air-pressure hose to empty shells as they passed on a conveyor belt. A conveyor belt was used to empty these cases on the 20 mm. and 240 mm. cases. Women were doing this work on shells of 80 and 60 mm. sizes.

2. Putting in bands or tags on the threads of shells—This was done to protect the threads while the shells were passing through a paint-spraying machine. Women were doing this work on shells of 80 and 60 mm. sizes.

3. Securing caps to shells—Women were being employed in this work in the shells moved along an assembly line. Women did not need to lift the shells and in at least one plant a few women were being used at times on a line where shells of the 15-mm. size were being assembled.

Amassling cartridge cases to shells.—In one plant women were
beginning the loading of cartridge cases and shell for the 20-mm.
size.

Shelling the main where projectiles and cases join.—Women
were doing this on some of the smaller sizes of projectiles.

Shelling case-to-case to shells.—Women were cleaning the
and operating pressing machines to stave the cases and form
to shells. In any instance men also were doing the latter
operation.

Smoothing propellant increases in the case.—Women were
fastening and shaping the propellant powder into the

Carrying the case to the machine where they were doing some
inspection of shells moving along a conveyer line, and occasionally
reaching with a point blank shells that had not been properly
covered by paint-spraying machines.

Women were stenciling the size, type, lot number, and
other necessary information on the sides of shells and packing

Containers. In some cases smaller shells were being packed into
individual cardboard containers by women, but the packing of shells
into larger containers, and most other work in the packing
department, was done by men. Without doubt much of this work
would be too heavy for women.

Bag loading.

Three of the bag-loading plants visited were already in operation
and women were being used very extensively for work in both
bag-making and bag-loading departments. In only one plant, however,
were they employed on the first important operation, which consists
of filling the bags with the proper amount of powder and the work
of a cutter in a clothing factory, and involves the use of an
electric power machine to cut through many thicknesses of cloth at a
time. In the company where women were employed on this
work they had been trained within the plant.

Women almost exclusively were being employed for the other jobs
in the bag-making department. Much the largest number, of course,
were sewing pieces of bags together on power sewing machines. The
small pieces must be sewed together carefully and securely, with care
of the proper kind, and a small opening must be left in each bag so
that it can be filled with powder. Some women in these departments
were operating the printing press used to stamp lot numbers and
other necessary data on pieces of the bags before they are sewed

A good many women were trimming and counting the
bags after the sewing had been done, and still others were inspecting
the completed bags very carefully. Some inspections were using
microscope to measure seams. Work in the bag-making department is not
hard work, but the women's labor, for the most part, is considerably
more strenuous than work in other sections of the plant.

In the bag-loading department the work is, of course, more
involved, since powder, and bags loaded with powder, must be handled.
The plant was not using women in these departments, but the other
two were using women extensively and a plant not yet operating was
planning to do so. Women were working in small groups, weighing
powder, checking it on schematic scales, and pouring the
powder through a funnel into the small openings left in the powder
bags. Then these openings in the bags were closed by women operating sewing machines with bronze needles. Women in another department then inspected and trimmed the baled bags, and other women assembled and hand them together according to specifications. While more women were working on lines where amnolose powder was being loaded into bags, some were working on lines where bags were filled with black powder, a more hazardous type of work.

In all bag plants men were doing the heavy work of bringing powder from storage houses to the loading buildings and of pouring the powder into hoppers. Also they were doing the heavy packing at the end of each assembly line.

Miscellaneous occupations.

A few women were bookkeepers, stenographers, supervisors, and inspectors in the larger plants visited, and in a few other plants there were some women foremen. Men in the larger plants, of course, had more experience than women, as they were hired, but such arrangement was rare. The great majority of plants had only the top production officials but also the line foremen and assistant foremen were predominantly men, even in departments where most of the workers were women. Of course, most of the women had been employed only a few months in most of the plants, in some instances only a few weeks. Partly, due to the nature of the industry very few women had had any experience in ammunition prior to the construction of the new plant, but it appeared that many more men than women had been given an opportunity to take the necessary preliminary training to fill them for supervisory positions.

There was a wide range in the number and ratio of women office workers. In about half the plants more than 300 women were employed in office work. No particular investigation was made concerning the kinds of work these women were doing, but most of them appeared to be engaged in the usual clerical occupations, such as secretaries, stenographers, typists, general office clerks, etc. In some plants were running full schedules of women office workers. In one plant it was stated that several women interviewers had had a considerable amount of training and did a specialized type of interviewing. In spite of the fact that large numbers of women were employed, or eventually would be, in many of the plants, comparatively few women had been taken on to do personnel work with women employees, but in a few instances there was a woman assistant to the personnel director or to the plant official in charge of recreation and welfare. In one plant it was stated that a trained social worker had been engaged as welfare director to give service to all employees.

Since first-aid and health facilities are necessary in ammunition manufacturing, professional nurses were found in all the plants. The total number of these was, of course, small. In each plant, also, women were employed as laboratory workers, laundry workers, part-time clerks, and custodians of maternity warders and charge nurses, where available. In the larger plants there were many women whose occupations were in the nature of minor duties in the office or in the shops, but in the industry some women have specialized duties in enforcing safety regulations concerning the type of clothing that must be worn in the
plants and the change-house routine that must be followed. In one plant, for example, the change-house crews and her assistants expected the women workers each day to be sure that matches, jewelry, and other forbidden articles were not taken into the explosive areas of the grounds. In some other plants such inspections were made at irregular and unexpected intervals.

**Future possibilities for women’s employment.**

As indicated earlier, the plants included in this survey expect to employ eventually about four times as many women as were employed in February 1942. The women employed vary in the kind of work they do and the number of hours they work. In some plants the number of women employees is expected to increase, of course, through the hiring of more women to operate additional lines as they are ready to begin production, and through the placing of operations on a full three-shift, 7-day-a-week basis. Therefore many women will be hired to do the same kinds of work on which others already are employed.

Further expansion of women’s employment in the industry will come also as a result of the beginning of production in new plants. Many of these will handle products similar to those now being made and hence the jobs for women will be much the same. Nevertheless, products will vary somewhat and there will be some difference in jobs. In one plant, which was expanding to produce a type of take-out being produced in any of the plants visited, women were hired to place Mission-disked shells into the ends of the tubes, to insert data on the outside of the tubes, and to clean, inspect, and pack them. The work will be quite similar to other kinds already done by some women.

If the present trend continues, it appears probable that women will be employed on similar types of work as they are now found in the existing plants. At the same time, plants which have not yet employed women reportedly are expanding and will add women employees. Men, who have been employed in only scattered instances at time of survey. Many plant officials foresee an eventual majority of male labor. Also, hiring shortage and lack of transportation facilities were reported to be serious problems in many areas. For these and other reasons onerous job enlargement interest was expressed in the possibility of extending the employment of women to other types of work, with a view to taking on more women who reside near the plants, including many from the families of individuals already employed.

In departments where components were being handled and measured, it would appear that women could be used for practically all operations except those requiring the handling of heavy boxes in packing departments, and it is probable that expansion of women’s employment will occur in such departments. Particular consideration could be given to the possibility of using women more extensively in departments that require less lifting, carrying, or pushing, and in which the machines are manipulated by turning switches and by watching the machines or conveyors rather than by hand.

However, on most lines producing components a high proportion of the workers already are women, therefore it is in shell-feeding lines, and in the assembling of complete rounds of ammunition, that a relatively greater expansion of women’s jobs may be feasible. For example, women probably could be used more generally to pour powdered TNT into shells of the smaller sizes. One official stated that he believed women could be used to operate the machines to press this powder into the shells through his plant was not so yet.
using women for this work. Also, since women were operating the presses to make propellants into the base, of cartridge cases in several plants, it was not considered unbalanced to have women engaged in the handling of work. Even as shells of 75-mm, 105-mm, or larger, were pressed, some plant officials thought that at least a few women could be used in the future. Such expansion would be dependent partly on the availability of men to do heavy lifting or the use of cranes or other mechanical equipment that would make heavy work unnecessary.

A few Army officers and other plant officials disproved the possibility of using women eventually in other kinds of jobs on which women were not employed at the time of this survey. For example, the possibility was mentioned of using women in some operations on lines where TNT is melted and poured into shell casings. Generally each work has not been considered suitable for women, as it involves considerable hazards, but, as has also been said, there is no reason to believe that women are less careful than men.

The opinion frequently has been expressed by persons in the industry that women are not as resistant as men to skin infections and poisoning from TNT, sulfur, and certain other powders. Individual women vary in their susceptibility to such infections and some women might be affected only slightly or not at all. In cases of emergency or serious shortage of manpower, women are tried experimentally on operations of this type, care should be taken to provide suitable uniforms, bathing facilities, milk for drinking, and other precautionary measures known to counteract the effects of exposure to various types of explosives.

It was reported in several plants that consideration was being given to the employment of a woman in the personnel department to take care of the problems of women workers. A report was received from one plant that a woman assistant to the line superintendent would be employed to look after the workers.

While this survey was concerned primarily with the work women actually did in current operations, and in some cases with the possibilities for their future employment in additional types of work, it was noted incidentally that plant officials that a considerable number of men were employed in office work. The possibilities of employing women in some of the office jobs were not discussed with plant officials but a few volunteered the opinion that a higher proportion of women would be employed in the future. In a number of plants, for example, young men were employed as reception clerks and interoffice messengers, but in one of the last offices visited it was noted that women were doing this type of work.

TRAINING AND GENERAL PERSONNEL POLICIES

Training.

Because of the nature of the artillery ammunition industry very few experienced women could have been available to work in the plants included in this survey. Moreover, officials of practically all the plants stated that no experience was necessary, and even the bag-taping plants, employing large numbers of power-sawing machine operators, were hiring chiefly inexperienced workers. Some sewing-machine operators, however, had received preliminary train-
ing through the WPA or NYA, and other workers may have had some general shop or factory training in NYA or vocational-school classes prior to employment.

In most of the plants officials indicated that the new women were performing required no great amount of instruction, and the female workers were being trained within the plants after employment. In one plant the training program included an 8-week period of instruction, which consisted in the setting up of training programs. In one plant it was noted that representatives of a state department of education were studying training needs, with a view to establishing a training program, probably a supplementary course, in a plant that was shortly to begin operating.

In one city a course designed to give training particularly suitable for women desiring employment in a nearby ammunition plant had been established by a public vocational school. A woman employed at the plant was doing the course, approximately four weeks in duration. The work covered shop mathematics, sewing-machine operation, machine-shop work, and training in the rapid assembly of a variety of washers, rivets, and wires. The most apt students were given additional training in micrometer reading and other special phases of work. In another city a course to give preliminary training in raw assembly and loading with inert material was being planned for a vocational school.

In general policy it was stated that plants to send a small number of key personnel to one of the Government schools to be trained as foremen, supervisors, and teachers. These people then trained the men and women of the other plants. Usually classes have been set up several months before production has started on any large scale, and classes normally would continue as long as large numbers of workers were being hired.

A few plants reported that women had been included among those sent to Government schools for training. One bag-loading plant, for example, had six women, and one shell loading plant had six. In one instance, though, it was stated that only men had been sent to Government schools and that all women had been trained in the plants themselves.

An official of one bag-loading plant stated that inexperienced operators work first on small lots of straight work in order to become familiar with proper work methods. Later they work with the more skilled workers and they progress gradually in type of work.

Frequently it was reported that women being trained to handle explosives are given preliminary training in the basics on the inert materials. For example, powder bags might first be loaded with corn or beans. A worker might obtain practice in weighing small charges of powder on very finely balanced scales and in pouring the powder into metal parts of ammunition, by going through all the operations using sand instead of powder. These working with inert materials are trained to follow the procedures and conditions necessary in handling explosives. One plant had constructed a model line solely for practice purposes.

Safety education is, of course, one of the most important types of training given to workers in such an industry. In addition to the
preliminary work with inert materials, plants normally instruct workers concerning safety measures, as well as various types of operations to be performed, by means of lectures and motion pictures. Special manuals and instruction books also are issued to employees.

No generalization can be made from the information obtained concerning the time required for training. This is due partly to differences in the degree of skill required for different jobs and to the amount of hazard involved. In some jobs the training period was said to be only two or three days. In more instances, though, 10 days, or two or three weeks, appeared to be considered necessary. The opinion was expressed in one plant that workers seemed to lose interest in their jobs of the training period with inert materials was longer than two weeks, and that new employees placed beside experienced workers to watch them for a few days before attempting to do much actual work with explosives themselves.

Rates of pay.

In the plant already in operation, minimum rates of pay for women operatives ranged from 45 cents to 48 cents an hour. In one-fourth of them the minimum was 40 cents, but in almost half the beginning rate was 45 cents or more. No definite statistics were available concerning the prevailing rates for women operatives in these plants. Since some plants had been operating only a short time, some officials thought most of their women employees were still on the beginning rates. Others said that a good many women had been advanced to higher rates. Three and one-half the hourly rate was being paid.

In a few plants there was a system of automatic advancement for women. At the end of a stated time, usually six to three months, in a good many instances, though, personnel managers stated that advancement was on an individual basis as ability was shown. In one plant an entire group on a production line normally would be advanced together, and could advance several times at the rate of 2 cents an hour. However, in this plant, as in fairly common, a maximum rate for each type of work had been set. A number of plants have worked out detailed systems of job classification and each job carries for a certain rate of pay. Therefore if a worker becomes skilled enough to be advanced to a more responsible job, she automatically receives the rate of pay for that job.

Generally, where each job has a specific rate hazardous jobs carry a higher rate of pay than nonhazardous. Several plants reported a minimum rate of 50 cents or 55 cents an hour for jobs that was in a day, which was an hour higher than the rates for workers in day shifts. Differential for work on second and third shifts were not very common. One plant reported that 5 cents an hour more was paid for those shifts, and in another plant workers on the night shift were paid for 8 hours though they worked 7½ hours. In a good many plants shifts were retained, which was one reason for paying no differential.

Reports were obtained in almost half the plants concerning the minimum rate for men operatives. In only 3 of these were women
and men started at the same base rate of pay, 30 cents in one plant, 60 cents in the other. In some plants the differential ranged from 60 cents to 20 cents. Women were employed to do lighter tasks, and men engaged in the heavy lifting for women workers. However, the opinion was expressed by some that there was no real justification for wage differentials between men and women in certain production operations. Expression was given also to the principle that if women were employed on the same job as men they should be given the same pay. It should be noted that some work being done by women, such as power-saving machine operating and the assembly of small parts, is considered unsuitable for men, yet these operations are of extreme importance to the production of ammunition as the lifting and packing of heavy objects, done traditionally and necessarily by men.

Scheduled hours of work.

In the majority of plants the scheduled hours for women factory operations were 52 hours of actual working time a week. The over-all time for each shift generally was 8 hours, with a break period of one-half hour. In some instances women were paid for this lunch period. Other plants had a scheduled working day of 6 full hours.

Two of the operating plants had 4-hour lunch periods; all the others had 2 hours. The average had scheduled lunch periods of only 20 minutes but had short rest periods morning and afternoon. In a number of other plants last periods of 10 minutes, and in one case of 15 minutes, were given twice a day.

The usual schedule for women was 4 days a week. However, because many of the plants were new, and most of them still were recruiting workers, certain irregularities in hours were reported. Those women who were working only 4 days a week, in 2 shifts, women had been working 7 days a week, but because of the heavy production during the war, the practice was being followed because of an emergency and was not to be continued indefinitely.

Several of the operating plants were using some women on each of the three shifts, and the larger number of others were employing them on two shifts. The remainder had women on only one shift. It was expected that many more women would be employed on second and third shifts as the plants approached peak production. Rotation of shifts was common in the first week of work on one shift before changing to another and two weeks, though two plants reported that shifts were being rotated weekly.

State laws concerning the working hours of women in manufacturing vary considerably in the States in which the plants are located. There are no laws governing the weekly or daily hours of women workers. One State has a limitation of 40 hours a week and 5 others have less. Nine of the other States permit a greater number of hours weekly, ranging the hours of work to 4 a day, and in 4 the hours are limited to 7 a day. Only 3 of the
States have less prohibiting or limiting the night work of women. Moreover, during the war emergency state authorities generally are issuing special permits or are making adjustments with respect to women's hours of work in specific plants engaged on war production where such arrangements are shown to be necessary.

Requirements for hiring.

In most plants the minimum age limit for women was 18 years.

In the beginning there apparently was a tendency to hire the younger workers, but over half of the operating plants reported no maximum-age restrictions for women. A number of women obviously over 40 were seen at work in some plants, but the majority probably were under 25. Most of the entering plants expect physical examinations prior to employment which usually included a blood pressure test; another plant was planning to give such examinations.

The physical examination requirement probably tended to favor the younger group of workers.

There were no restrictions against married women as employees.

No specific information had been compiled in the various plants, but a number of personnel managers estimated that probably about half of their women employees were married. In some cases there was definite interest in recruiting more married women from the nearby towns to work in the plants. This was especially feasible because of the absence of any necessity of previous experience.

Because of the character of the industry all workers in these ammunition plants must be citizens of the United States. Investigation of an applicant's previous employment record and general background and character is made in all cases by plant officials and members of the Federal Bureau of Investigation. Some application blanks call for many references, and interpretations are taken of all prospective employees.

Food service.

Because of the large areas covered by these ammunition plants and the scattering of the buildings at considerable distances, the problem of providing hot food for the workers is difficult. A cafeteria near the administrative buildings is far away from the production lines to serve the workers of both plants except in a few of the operating plants visited. Eight plants had made some provision to get food to the production departments. In a few of these the central canteens were near enough to production lines to be used by all workers; where it was not, the plants had solved the problem by the construction of canteens in the nearby buildings or in other buildings adjacent to the plant, or by transporting lunches.

For the most part the lunch was the same as that served at the central canteens. In the plants where lunch was served in the central canteens the cost of meals was paid by the employees. In the plants where lunch was served in the plants it was stated that most workers were bringing their own lunches. Officials of several of these plants told that some consideration was being given by the companies to the possibility of erecting lunch facilities and of transporting food to the lines. Two plants apparently had given no particular consideration to making provision for serving any type of hot food to the plant operatives.
Uniforms.

Three-fourths of the plants already operating reported that some women employees were required to wear uniforms, and at least two others expected to have uniforms later. In a number of plants only those women in hazardous occupations, or in certain types of hazardous work, were required to wear uniforms. At the time of visit, women in bag-making departments generally were not wearing a uniform. In some plants, however, the women in the mixing and handling departments were being required to wear a uniform. In others, the practice was being discontinued as the various types of uniforms were being made, some kind of washable stack coat and a cotton one-piece dress. For purposes of safety, all pockets and rubber buttons were commonly used in these uniforms.

Some plants stated that employers' uniforms were provided by the company, but in instances where the employees were required to provide their own, all handling was done by the plants. This is really essential from the point of view of safety. Persons working in explosives departments are required to wear safety shoes; also, there are other safety regulations generally followed, such as stipulations against the wearing of metal bracelets and jewelry, or any other kind of metal, in areas where such articles might cause an explosion.

General working conditions.

SPECIAL attention was paid during the construction of the new plants to the provision of certain facilities as able to safe operation, which had been found necessary in the other plants, and to ensuring safety in the old buildings. The new buildings generally are well ventilated, well lighted, and well insulated. Fluorescent lighting systems are used frequently. Obviously all buildings in explosives areas must be built of noninflammable materials. These buildings are situated at considerable distances from each other for purposes of safety, and "shelter houses" or "bombproofs" to which the workers can go in case of an electrical storm or other emergency are near the production lines.

The new buildings generally are provided with many exits. For example, in one rather typical building visited it was noted that there were doors into each end of every work table. The buildings usually were only one floor in height; but in instances where buildings had more than one floor, doors had been provided down which workers could slide from the second floor in case of an emergency.

Other safety measures, not all of which can be mentioned in a brief report, are common in all plants. Bag-making and certain other hazardous work is done in very small compartments enclosed by thick walls or barrier wall so that an explosion, if one occurred, would not damage or harm any other workers. Announcing the number of persons and the maximum amount of explosives allowed in each particular room or compartment generally are posted in the buildings.

Because of the distances to be covered, transportation within and between the buildings is essential. Usually this appears to be supplied by special buses operated by the plants themselves.

Hospitals, first-aid facilities, fire and police protection are essential in ammunition plants. All plants reporting had hospital facilities or
were constructing them. Nurses, doctors, and persons trained in first aid were available. Also, all plants but one stated that extensive medical examinations were required for workers; the other planned to require such examinations when its hospital facilities were completed. Some plant officials stated that periodic medical examinations were to be given, but complete information on this subject was not obtained.