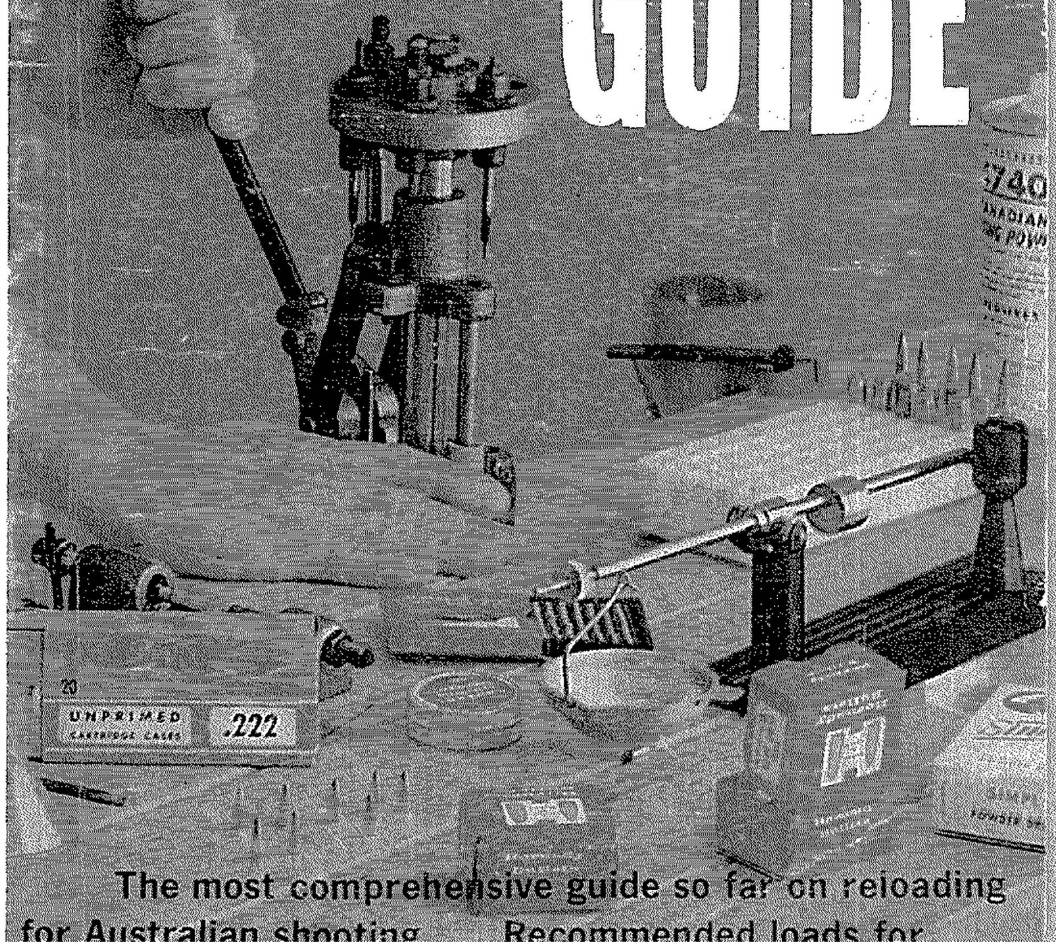
SPECIAL TEST REPORT ON AUSTRALIAN POWDERS

Australian OUTDOORS 76

HANDLOADING GUIDE

By world Top Experts
COL. TOWNSEND WHELEN,
COLIN SHADBOLT



The most comprehensive guide so far on reloading for Australian shooting. Recommended loads for

Australian OUTDOORS

HANDLOADING GUIDE

By Colonel TOWNSEND WHELEN
and COLIN SHADBOLT, B.A.

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FOREWORD

NOT long before his death in 1962, OUTDOORS Magazine secured the Australasian rights to one of the most successful books by the world's foremost handloading authority, Colonel Townsend Whelen. This little book, *Basic Reloading*, had been hailed in America as a superb condensation of all the master handloader's skills. We considered that with a little editing to "Australianise" it, plus a few additions about Australian powders and cartridges with which Colonel Townsend Whelen was not familiar, this book would prove the one Australian and New Zealand handloaders have been waiting for — a simple, easy-to-read guide which answers all your handloading problems. Accordingly, we invited Colin Shadbolt, Australia's outstanding expert on sporting firearms and cartridges, to combine his know-how with that of Colonel Townsend Whelen's. We believe the result is the best popular reloading book on offer to Australian shooters.

Townsend Whelen practically grew up with handloading. Many of the processes he describes herein he developed himself and gave to riflemen in his articles for sporting magazines and in his books. He gained much valuable experience from a stint — 1919 to 1922 as commander of America's Frankford Arsenal. He was an intimate of many famous handloading authorities, including Dr Walter Hudson, the late J. Bushnell Smith and A. H. Barr, of the US National Rifle Association's Technical Staff. At the time of his death Townsend Whelen was regarded as the master of all the authorities on handloading, and his book, *"Why Not Load Your Own?"*, published by Barnes and Co Inc was rated the handloader's bible.

Colin Shadbolt, a wartime sniper, a one time professional 'roo shooter, tutor to many Australian rifle shooting cracks, has in the past few years built an amazing following among sporting shooters.

A graduate of Sydney University, he is a meticulous man, painstaking and tireless in his efforts to absorb the ballistic sciences. Shadbolt is a controversial figure among firearms distributors because of his caustic criticisms of certain arms. Rifles have even been withdrawn and modified because of his comments. Like Townsend Whelen, Shadbolt is a first-rate shot, a handloader for most of his shooting life.

Between them, these two authorities have produced a splendid guide on how to reload your own ammunition. In addition Shadbolt's special Australian powder guide gives buyers of this guide a special bonus.

This manual owes a lot to all the firearms trade, but in particular to Keith Herron, agent for Hornady, Lyttle and Westaway, Australian agents for Norma, and Kerry Armit, of Asher Smith, Australian representatives of Lyman. Paul Trenoweth took the cover transparency and the black and white photographs scattered through the book. We sincerely thank them.

— JACK POLLARD, Editor,
Australian OUTDOORS Magazine

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Photographs by Paul Trenoweth

CHAPTER ONE

The Advantages of Handloading

SUPERIORITY. Factory loaded cartridges are a wonderfully developed and satisfactory product; standardised, dependable, sure-fire and safe. However, it is possible to handload cartridges, or to reload fired factory cases, so that they will be more accurate in a particular weapon, or more suitable for a particular purpose than are the standard factory cartridges.

Mass production rifles, pistols, and their ammunition must of necessity have certain manufacturing tolerances. The largest and heaviest loaded cartridge of a certain size must fit into the smallest bore and chamber of any factory rifle of that calibre and be perfectly safe in it even if that weapon is dirty and rusty, and the combination must be safe in tropical heat or arctic cold. Such tolerances are incompatible with the finest accuracy.

However, the handloader can use a cartridge case that has already been expanded, by being fired in his individual rifle or pistol, to a perfect fit in that chamber. He can use a selected factory or handmade bullet that fits the particular bore of that weapon perfectly. And he can use a powder charge weighed to 1/10th grain. By choosing his components, which can be varied at will, the handloader can produce ammunition which will give more accurate results in a certain rifle than any other load.

As a rule the ammunition factory manufactures but one type of cartridge for one type of weapon. Thus for big game rifles they make cartridges suitable only for big game; for small game rifles, cartridges suitable only for certain species of small game; and for target rifles, cartridges suitable only for target shooting. But for his big game rifle the handloader can produce cartridges more suitable for long range varmint shooting, for shooting small game where he does not wish to destroy meat or pelts.

Economy. When a factory cartridge is fired, the brass case remains. This is the most costly of all the components that make up the factory cartridge. This brass case can be reloaded many times, and the cost of all the other components which are used to reload is a small fraction of the cost of the factory cartridge. The following cost of reloading certain typical cartridges, the fired case being available for salvage, is based on the retail price of factory loaded cartridges and components, and on the assumption that the handloader does not charge for his labor. Handloading is such an interesting, instructive and profitable hobby that I know of none who regard it as "labor."

Not only will the confirmed handloader re-load fired factory cases, but when he buys a new rifle he is likely to proceed a step further and buy unprimed brass from firms like Norma and Metallverken, and then establish loads for the rifle for various purposes without bothering to even try the factory product at all.

By reloading the fired cases we can show the following savings on factory cartridges which cost £12/16/6 per 100.

.257 Roberts — .257/.303 Harrison Magnum. Pig and 'roo loading, consisting of a 100 grain projectile at 3200 fs.

	£	s	d
Primers . . . Boxer		12	6
Powder . . . 49 grains 4831	1	3	0
Projectiles . . . Taipan	2	0	6
Total	£3	16	0

.257 Roberts — small game, target and practice; consisting of an 85 grain gas check loading at 2000 fs.

	£	s	d
Primers		12	6
Powder . . . 25 grains 4740		11	9
Projectiles — gaschecks		7	0
Total	£1	11	3

Thus in the reloaded cartridges, there would be a saving of £9/0/6, and in addition a gain in muzzle velocity and power over the factory round which is loaded to 2900 fs with a kinetic energy of 1864 ft lb. The re-loaded round driven at 3200 fs would have an energy figure of 2270 ft lb, a gain of 404 ft lb.

With the gas check 85 grain bullet driven at 2000 fs, this loading would have an energy figure of 764 ft lb which is better than the .22 Hornet and with a velocity flat enough for surefire hits on small game up to 150 yards. The lead bullet kills well without ruining pelts, and would be ideal for fox, dingo and the larger fowls.

The .38 S & W Special revolver cartridge, Match type loaded with a 148 grain wad-cutter, lead alloy bullet, cast, sized and lubricated by the handloader.

Cost of factory cartridges — £4/10/- to £5/16/9 per 100.

Cost of components —	£	s	d
Primers — small pistol		12	6
Powder . . . at £3/8/6 per lb		13	2
Lead, tin, fuel, etc		8	0
Total	£1	13	8

There are many sources of supply of top flight match bullets should the reloader not seek to carry out this chore himself, and by substituting £1/11/- for the 8/- of the completely home made product, the best products of the world famous factories are available for use by the handloader. Thus the shooter still will show a substantial saving.

The .38 S & W Special cartridge seems to be the only one where it is hardly possible for the handloader to quite excel the factory product in accuracy and dependability. Practically all of our leading revolver shooters use factory loaded cartridges in important competitions, but at other times, and particularly for practice, they use handloads. In fact, if one desires to really excel in revolver marksmanship he must practise to the extent of thousands of rounds annually, and the economy of handloading becomes imperative. As a consequence, more .38 S & W Special cartridges are handloaded annually than any other calibre.

Of course, an actual saving does not occur until enough cartridges have been reloaded to make the saving therefrom offset the initial cost of the loading tools. Thus, if the original cost of the tools is £14/6/6, and the saving is £4/13/1 a hundred rounds, a real cash in the pocket saving does not result until 300 rounds have been reloaded. That is, you start with 100 rounds of factory cartridges, you reload each of the fired cases three times, and then, your tools having paid for themselves, your real saving starts.

Suitability for various purposes. Factory cartridges are usually suitable for one particular purpose only. Thus, most factory cartridges for the heavier rifles are good for big game shooting only. But it is possible to reload these cases with other loads suitable, and in many cases eminently satisfactory, for any of the following uses:

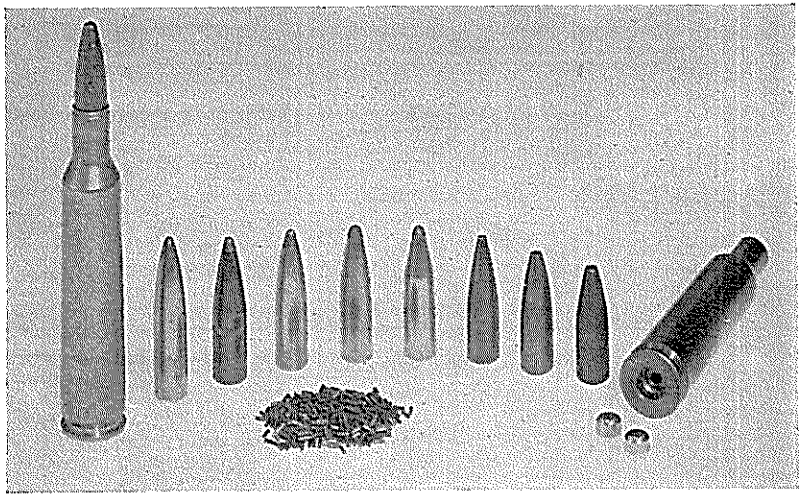
- Varmint shooting, often to extended distances.
- Small game shooting where you want to preserve meat or skins.
- Economical target practice.

Thus, the shooter can make one rifle do for many purposes.
For example, if the shooter is a man who buys a heavy calibre arm

with the object of going on that big safari one of these days — but must use it in the meantime on much smaller game than he finally hopes to encounter — he may well adapt his loadings in the following ways, and at the same time have the advantage of using and getting used to the rifle he will finally use on dangerous game: Take a cartridge like the 7 x 61 S & H. There is little general use for a 160 grain bullet leaving the muzzle at 3200 fs and reaching out to 300 yards with much the same energy as a .303 at the muzzle.

By loading the 120 grain bullet at 3000 fs this heavy cartridge will burn a cheap and readily available powder like 4740 with excellent accuracy, and give a flat shooting and deadly load on 'roos which will not damage skins. It may further be loaded back using the 80 grain soft point bullet to 2000 fs and make a good wallaby and dingo rifle with a very soft recoil burning a powder like Norma 200.

But if our rifleman gets a chance at pigs, he can load a 150 grain bullet to 3000 fs if he feels he needs it, although 2600 to 2700 fs will bowl the largest tusker. Should he encounter large deer he can load 160 to 3000 fs and when he meets up with crocodile or a long shot at true big game like a seladang or tiger he can push a 175 grain soft point bullet down that barrel with all the traffic it can bear to the tune of 3000 fs of velocity and over a ton and a half of energy.



This picture shows the tremendous choice the handloader has in varying the cartridge to suit his particular needs.

In such fashion the reloader gets a chance to use his heavy rifle in the course of everyday hunting, and so get used to its balance and feel in preparation for what may well be the moment of truth.

A less obvious reason for reloading lies in the use of special high velocity rifles like the .220 Swift. These when used with factory cartridges have a very short barrel life seldom going past 1500 rounds before accuracy begins to fall off.

Marksmanship. Basic marksmanship can be, and very often is, learned from shooting a small bore rifle using the economical .22 Long Rifle cartridge. But if the shooter wants to use his centrefire rifle for acquiring this basic skill, then generally speaking, he will fire upwards of a thousand rounds, and the economy of handloading becomes almost a necessity.

Knowing your rifle. It has been our experience that knowing your rifle, its zero adjustments, its elevation for all distances, trajectory, wind allowance, at various distances, value of sight adjustments, accuracy, peculiarity of grouping its shots, etc, so that you can use if for competitive target shooting or successful game shooting, requires the expenditure of at least 500 rounds in careful and recorded target practice. Here again the economy of reloading becomes very desirable.

Effect on the arms industry. At first glance one would think that reloading and handloading would have a detrimental effect on the sale of factory loaded cartridges, and therefore on the business of the large arms companies. In practice, the effect is just the opposite.

In America it has been found that the average sportsman who shoots a centrefire rifle or revolver and who does not handload, buys about 40 rounds of factory ammunition a year. He uses 20 rounds for sighting in his weapon and the other 20 rounds for hunting. If he is a small game hunter and uses a rifle like the .22 Hornet, he probably buys not more than 150 rounds of factory cartridges a year.

But the reloader almost invariably becomes an enthusiast, and on an average he can be counted on to purchase about the following from the ammunition industry each year:

100 rounds factory cartridges.
100 rounds primed cases.
1000 primers.
500 bullets.
5 lb powder.

Also, as the years go on, he very probably purchases a rifle of another calibre for hunting or for experiment, and makes similar purchases of cartridges and components for it. #

CHAPTER TWO

How to Make a Start

A **CERTAIN amount of danger** would seem to attend the handling of explosive powder and primers. It would be extremely foolish and unsafe for anyone to attempt handloading without first studying a good instruction manual or handbook, and then using it constantly as a reference. Personal instruction is not sufficient, for an instructor is only human, and may forget or neglect some safety precaution.

All the necessary safety precautions are given in this book, and are emphasised in *italic* type. We believe that anyone who follows the instructions carefully will reduce danger to the zero point. *However, we do not assume any responsibility.*

But we can say that we have never heard of any accident resulting from handloading — where the handloader followed a good manual — that was not due to sheer carelessness. We know of no successful law suit arising from handloading. So far as we can estimate there are over 300,000 shooters handloading in the United States. But, handloading is not for the man who is habitually careless, or who cannot follow plainly written instructions, or who thinks he knows more than the experts.

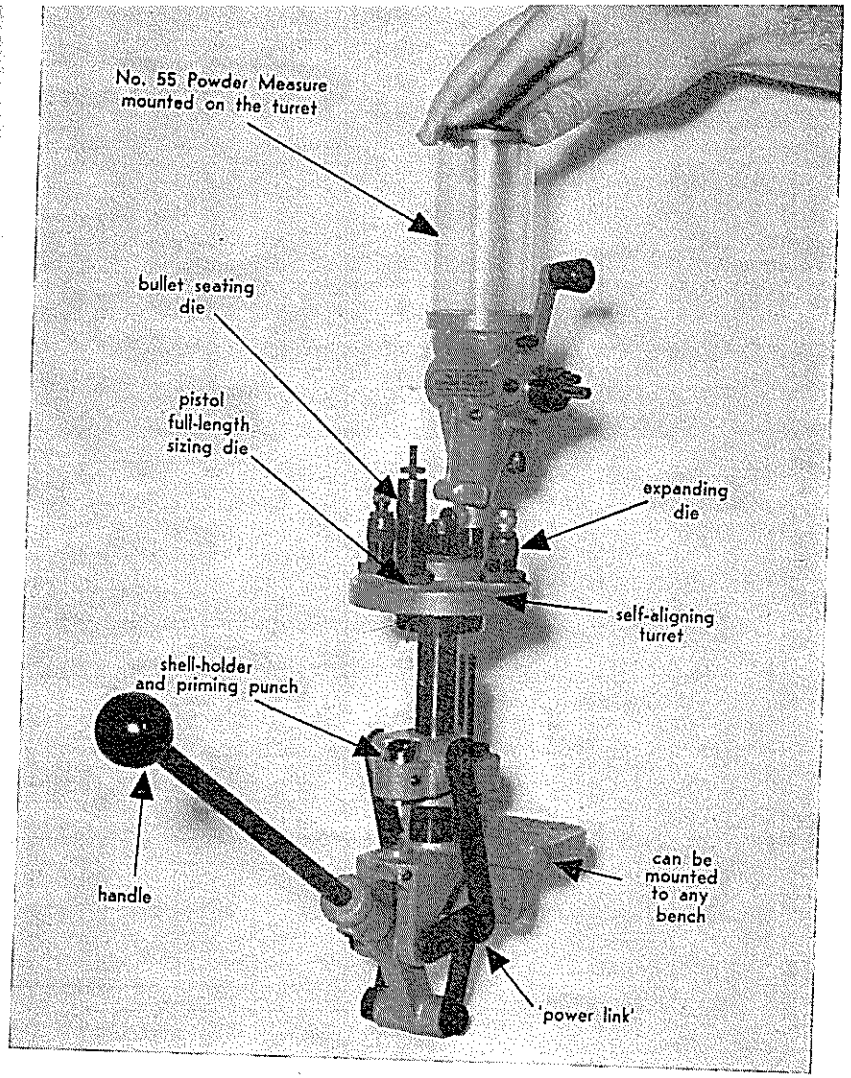
This book tells in precise and clear detail how to load or reload a cartridge for use in a rifle or pistol. First, each step in the process of loading is given and described in sequence, beginning with the fired or empty cartridge case, and ending with the complete, loaded cartridge. Then bullet making is described. Specific instructions for loading all the more important and commonly used cartridges follow, and the most useful and best loads that have been developed for each particular cartridge are given. Finally there is an Appendix that gives all the tabulated data and work tables that are necessary.

What cartridges can be reloaded. Only centrefire rifle and pistol cartridges can be reloaded. It is not possible to reload rimfire cartridges. It is more difficult to reload foreign makes of cartridge cases as most use the Berdan primer. All American centrefire cartridge cases use the American (Boxer) primers which are sold everywhere.

We do not include instructions for reloading shotgun shells because that involves a very different technique and requires its own handbook.

RELOADING TOOLS

This book is written so that the instructions apply to all standard makes of reloading tools. The method of operating each make of tool differs, but is fully described in the manufacturer's instructions. It has been our experience that entirely satisfactory, in fact top notch reloading, can be done with any of these standard makes of tools. It is entirely unnecessary to purchase the most expensive or the latest models of tools. If you seemingly fail to load well with one tool (provided it has no obvious defects) don't rush out and buy some other tool. Usually a little more care in using the tool will solve the problem. Some tools are more convenient than others, and some are faster than others. You should buy more for convenience than anything else,



The Lyman Tru-Line Reloader. Lyman is the only overseas maker of reloading tools to make an impact in Australia.

and this makes a choice a matter of personal preference. Some manufacturers produce a basic tool for reloading one cartridge, and then you can purchase as extras the various dies and holders for loading any other cartridge in that tool. As most handloaders end up in loading for many different cartridges, either for themselves or friends, I think it is often wise to choose this type of basic tool.

For years satisfactory loading was done with the old Ideal tong tool, but it is best to buy a good, heavy bench tool at the start because it will do better work, do it faster, and is much more convenient. Buy this tool to use the standard 7/8 in. by 14 seating and resizing dies because they are as a rule, better than the others, and can be had of many makers, are all interchangeable, and can be had for all rifle and pistol cartridges. Thus, you can use any bench tool to load any number of different cartridges, and all that is necessary is a set of dies for that cartridge, and a shell holder for

that particular case. Many cartridges have the same size head and use the same shell-holder.

It is not an advantage to have the bench tool fitted with any automatic primer feed. It takes longer to fill the automatic feed, all primers faced the same way, than it does to feed the primers with the fingers, one at a time, into the priming arm. The advantage of the multiple turret tools, where the head of the tool holds two or more dies is debatable. They are much more expensive than the single die tool. Only one operation should be done at a time in order to inspect the product of that operation before proceeding to the next, and it takes only a few seconds to remove a resizing die, and insert one for bullet seating.

For individual handloading, not for profit, it is best to buy a tool which does one operation at a time, except the operations of decapping and neck resizing which are almost always done in one operation. This enables the handloader to inspect each cartridge as it passes through each operation. This step by step inspection is quite necessary for the best results, and it eliminates the chance of ever finding a defective cartridge among the batch you have loaded. Moreover, the "one operation at a time" tools are just as fast as those designed for faster and quantity production.

In addition to the reloading tool proper, a powder scale for weighing the powder charge, and a powder measure for expeditiously throwing the charges into the cartridge cases are necessary.

As well as the above, certain small accessories which do not appreciably increase the cost are quite desirable, such as: Two small funnels, one for .22 and .25 calibre, and one for larger, used to guide the powder into the case. Two loading blocks. A case-mouth chamfering tool. A jar of lubricant for lubricating cases. A pair of inside and outside calipers, complete with depth gauge, reading in both inches and millimetres of four to six inches for measuring case and cartridge lengths. A set of micrometer calipers, capacity 1 inch, reading to thousandths of an inch is also desirable, while a set of small plastic spoons for adding powder to the scale pan is a virtual necessity.

If you want to make your own lead alloy bullets, then a bullet mould, a melting pot, dipper, a lubricating and sizing tool, and some make of furnace or burner for melting the lead alloy are necessary. For making metal cased (jacketed) bullets a set of bullet forming dies and a uniform weight case forming die are necessary.

A workbench or table on which to secure and use the tools, and shelves on which to store tools, accessories, and components are desirable. Much ingenuity can be employed in arranging convenient and comfortable working conditions. On the other hand special facilities and rooms are unnecessary. There are several portable bench rests for shooting arranged so that they form a loading table, that could be transported in the luggage compartment of a car and set up anywhere.

A list of all the standard and better known makers of reloading tools, reloading accessories, and components for handloading, with their addresses, will be found in the Appendix. Consult the text and the columns of Australian OUTDOORS Magazine and Gregory's Guide to Australian Hunting and Shooting for tools that might be offered after the publication of this book.

CHECK LIST OF EQUIPMENT

The following is a complete list of the loading tools and equipment:

2 Loading Blocks for each cartridge
1 Case trimming tool
1 Small jar of lubricant for lubricating outside of cases (any chemist)
1 Small jar finely powdered graphite for lubricating inside of case necks (any hardware store)
2 Screwdrivers filed to proper size for scraping powder fouling from corners of large and small primer pockets, or else the standard primer pocket cleaners
Graduated calipers for measuring case and cartridge lengths

1 Machinist's micrometer
Several screwdrivers of assorted sizes, wiping rags, etc

In addition, should the handloader desire to cast his own lead alloy bullets he will require about the following:

1 Bullet Mould for each bullet he desires to cast
1 Metal Pot (Ideal) or electric furnace
1 Dipper (Ideal)
1 Old tin pan for dross and spoon
1 Pair old gloves
1 Apron
1 Wood mallet or club.
1 Lubricator and Sizer with dies for each diameter of bullet, and a separate top die for each different bullet point.

A sturdy work bench (suggest 4 in. by 4 in. legs and 2 in. plank top) is very desirable, and a large machinist's vice, hammer, files, etc, always come in handy.

COMPONENTS FOR RELOADING

In addition to the tools above, one must also have the components for reloading — the primers, powder and the bullets. The large ammunition companies, as a rule, do not sell components for reloading to individuals, but instead sell them in quantities to dealers. There are a large number of dealers who specialise in selling components to handloaders. These dealers not only sell the primers and bullets made by the large ammunition companies, and smokeless powders of all kinds, but often as well sell other components, chiefly bullets, made by certain small custom makers. The handloader will probably wish to purchase from the nearest component dealer and thus save transportation.

REQUESTS FOR INFORMATION

Requests for information on handloading (except for catalogues of tools, or prices on tools and components) should not be made to the arms and ammunition companies, nor to the makers of reloading tools or dealers in components. These firms have no facilities or time to answer letters of inquiry, and in most cases they do not have the information, or it may be biased. Such correspondence is a continual handicap to these organisations and firms, reduces their profits and the service they can give to their customers, and eventually increases the cost of their product.

All letters requesting special information on handloading or other matters connected with rifles and pistols should be addressed to Australian OUTDOORS Magazine, 142 Clarence Street, Sydney, NSW. OUTDOORS experts have the experience and facilities to answer such inquiries, and their replies are unbiased. In writing letters of inquiry, make them brief but exact, come quickly to the point.

It may interest the writers of letters of inquiry to learn that five percent of such letters cannot be answered, and that about 15 percent of the remainder very greatly increase the time and cost of replying because the name and address of the writer was not clearly printed on the letter. On the envelope is not sufficient. #

CHAPTER THREE

Bullet Moulding

FOR many years the reloader had no choice but to mould his own bullets. This was purely due to the fact that the cartridges and the rifling of the rifles were suited only to low velocity projectiles which were sufficiently soft to expand and fit the barrels of the rifles in use. With modern cartridges and higher velocities the shooter was then in a situation that he could often make his big game rifle double up for small game work by reloading with lead bullets.

This business of casting lead bullets, using them in place of jacketed ones, means that the shooter can reduce his costs very markedly and so use his big game rifle for shooting rabbits, foxes, wallabies, dingoes and suchlike at a cost very little more than if he took a .22 rimfire rifle with him. Furthermore he had the added advantage of a very marked gain in striking energy of the heavier, larger diameter bullet. He can adjust the loading to exactly suit his present needs.

Casting lead bullets is one of the simplest of all reloading procedures. It needs access to a gas stove where lead can be heated in a pot and a small amount of kitchen space to cast the bullets.

Moulds may be bought either of local or American manufacture to cover every circumstance which may be desired.

The small flat nose of the gas checked mould is preferable for use in the rifle which has to double up for big game, as this is often of small calibre. The flat nose assists expansion markedly and the gas check on the base prevents fusing of the bullet composition once velocities get over 1600 fs.

With calibres in excess of .25, it may be found desirable to use a sharp pointed bullet as, due to the weight of the projectile, it will frequently penetrate an animal completely, tearing the skin badly at the exit hole. The sharp pointed bullet avoids this and at the same time gives adequate killing power.

Procedure is as follows:

The gear needed is a melting pot for lead and tin, a mould, a bullet dipper, a discarded spoon, an old jam tin or container of some sort for the dross, a small piece of beeswax about the size of a nut for fluxing the lead mixture, and a convenient sink.

The most useful mixture for casting bullets consists of a bar of 50/50 solder and seven times its own weight of good scrap lead. This scrap lead can be obtained from a variety of sources — cable sheathing, dampcourse, sinkers and so forth.

It is not advisable to use Linotype metal as this is very hard, containing a large percentage of antimony which causes the bullet to expand as it cools and so gives oversize bullets. It also has the disadvantage that it leaves behind a very much greater percentage of dross than will the lead/tin mixture and unless this is skimmed off very carefully it will cause difficulty in pouring the lead from the dipper into the mould.

To get the business under way, the pot with a small amount of soft lead in it is placed on the stove. Once this lead melts, much larger pieces of lead can be slid into the side of the pot and will melt very quickly. It is advisable to wear an apron of some sort, and leather gloves, as splashes of molten lead can be most disturbing, especially when they land

about waist high and burn through a shirt. The ordinary khaki shirt should be avoided for bullet moulding as a splash of hot lead will cause a spot to appear and burn with danger to the wearer.

The preferred composition of bullets varies markedly with the use to which they may be put. A bullet to be used in a rifle like the British .303 in the quick twist rifling of one turn in 10 ins. and driven at a velocity of 2000 fs, would need to be markedly harder than a light .22 bullet driven in a twist of one turn in 16 at a velocity of, say, 1600 fs. This additional hardness has little effect on the ability of the bullet to kill small game, as the larger diameter of the .30 calibre bullet more than makes up for the loss of expansion due to the use of a harder alloy. Bullets for use in quick twist rifles of one in 10, or one in 12, intended for velocities of 2000 fs or even slightly higher up to 2200 fs may well be made of a composition of one part of tin to 10 to 12 parts of lead.

This same mixture would apply to bullets for use in automatic pistols. For normal use, though, the mixture of one part to 15 of tin and lead will be found satisfactory for gas checked bullets in normal twist of rifling of one turn in 14 or 16, for velocities with gas checked bullets up to 2000 fs and for ordinary plain-base bullets at velocities to 1600 fs.

Revolver bullets differ quite markedly from the rifle bullets in depending almost entirely on their expansion to secure effect. In revolvers with muzzle velocities of 600 to 800 fs, the bullet can well be cast one part in 30 of lead and tin. Up to 800 to 1000 fs, the bullet needs to be about one part in 15. From 1000 to 1200 fs, the bullet needs to be one part in 10; and above this figure, the plain-base bullet is of no further value and a gas checked bullet of one part in 15 is the softest that can be used for velocities between 1200 and 1400 fs.

Leading becomes a very marked problem once the 1200 fs mark is reached and in some revolvers it will even be found necessary to shift to a gas checked bullet of one part in 10 from 1200 fs. This is purely due to the development of cartridges like the .357 Magnum, .256 Winchester, .221 Remington Fireball and to a lesser extent the .44 Magnum.

The gas checked bullet recommended for these revolvers is preferably of the deep base type as opposed to the shallow brass cups which are frequently used on American projectiles.

Now let's get back to our melting pot.

By this time, our mixture of lead and tin should be well and thoroughly heated. If the stove is too hot, the bullets will have a frosted appearance and the bright surface of the lead mix will need continual fluxing and cleaning to get oxidisation.

In the initial setup, once the lead and tin have melted, the mixture should be well stirred with the ancient kitchen spoon in case the tin, being slightly lighter than the lead, tends to stay on top of the mix.

The piece of beeswax is taken, dropped on top of the hot mix, and then the resulting cloud of evil-smelling smoke is ignited with a match, taper, etc. This is not completely necessary, but if done inside a kitchen the melting beeswax will leave dark, oily smoke hanging about and may cause some domestic animosity. Immediately the mix is fluxed, various bits of dross will settle on the surface and float around. This should be scooped off immediately with the kitchen spoon and put in the old jam tin which is kept for this express purpose.

At this stage of proceedings you are ready to start casting bullets.

The mould is taken in the left hand, the lead dipper in the right, and the dipper half filled. The spout is placed against the hole in the sprue-cutter in the mould and then the pair is tilted so that the lead runs into the mould. They are held together for a few seconds and then the dipper is detached and put on top of the molten mix. A piece of wood like the leg of a chair, or something similar, is immediately picked up and the sprue-cutter struck a sharp blow to cut off the sprue, which is attached to the base of the bullet.

The fingers of the left hand are unclenched and this opens the jaws of the mould. It is tilted to allow the bullet to fall out on the blanket.

The first few tries will result in bullets which have a wrinkled appearance. This is due to the fact that the mould is not hot enough. It is suggested here that the casting then continue until 10, 12 or 15 bullets have been cast, at which stage the bullet then should fill the grooves of the mould correctly and should have a smooth, even texture all over.

Some authorities overseas are of the opinion that the mould should be pre-heated by setting it above the melting mix on a stand of some sort or by actually heating in the gas flame. With cast iron moulds this may possibly be quite all right, although such moulds have been known to warp when exposed to heat on one side only. With the phosphor-bronze mould, which is of local manufacture, no preheating is advised. This type of mould will cast a particularly good bullet in a much shorter space of time than will the cast iron type and preheating, if carried to excess, will cause lead smears across the face of the mould when the sprue-cutter is struck, due to the failure of the bullet to harden sufficiently quickly.

Some difficulty will probably be encountered with hollow point bullets, which are markedly harder to cast than the standard type, as the point often fails to heat enough to give a smooth, even bullet. In this case, merely continue casting a little longer.

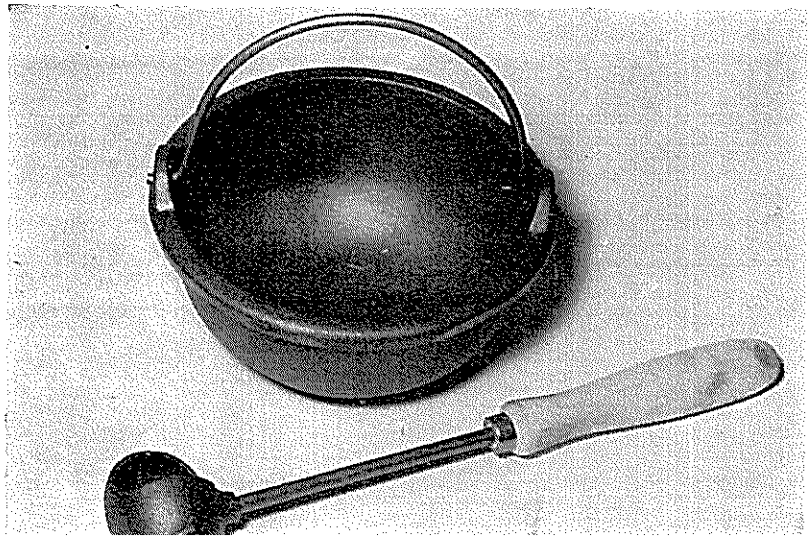
Once the molten mixture has reached operating temperature, it is advised to continue as fast as you can. Once a definite rhythm becomes established, bullets can be cast at the rate of 300 an hour. When the mix appears to be getting covered with dross again, it is advisable to stop, return all the defective bullets to the pot, gather up all the sprues. Be careful when returning any material to the melting pot.

This unused lead can be left in the pot to form a starting point for next time.

Lead bullets should never be used in a rifle without being lubricated, and if they are of the gas checked variety, gas checks should be attached now, before lubricating. To lubricate the bullets they can be run through an Ideal bullet lubricator and sizer as overseas moulds are usually cut .003 in oversize while local ones are dead size.

If a lubricator is not available, the bullets should be stood base down in a shallow pan and a mix poured into the pan consisting of beeswax, water pump grease ("steam" grease) with some air floated graphite to darken the mix. This should be used sparingly. The lubricant should be stiff as otherwise it will run down on top of the powder charge in hot weather.

A lead melting pot and Ideal bullet-dipper.



CHAPTER FOUR

Handloading — Step-by-Step

THE various operations involved in reloading a brass cartridge case that has been fired in a certain rifle, for use in that same weapon again, are as follows:

(a) Chamfering the mouth of the case.
(b) Decapping — pushing out the fired primer.
(c) Resizing the neck of the case. (Operations (b) and (c) are usually done at the same time.)
(d) Repriming the case, and inspection.
(e) Charging the case with powder, and inspection.
(f) Seating the bullet.
(g) Final inspection and labelling.

In the above sequence each of these operations will be described in detail for cartridges in general, and certain departures from the general rule will be mentioned.

You save the cases you fire in your rifle or pistol for future reloading. Try not to let them fall in the dirt or sand where they might gather grit, and when you get home wipe each case off outside only with a slightly oily rag. Particularly wipe the powder smudge off the outside of the neck.

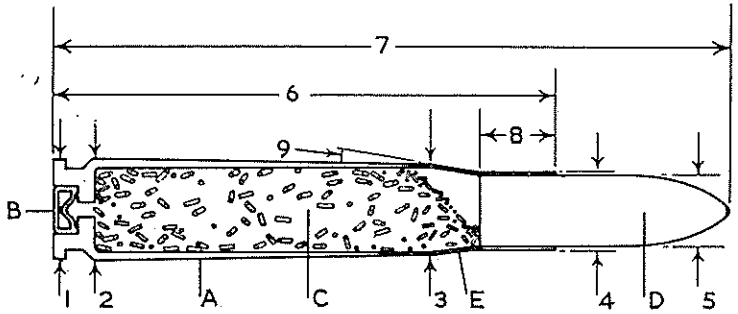
It is best to decap the cases as soon as possible to prevent any possible corrosion in the primer pocket, but practically, in a dry climate, no harm will result if they are left a month or two without decapping. Better place these fired cases in a cigar box, and include a slip of paper showing in what rifle they were fired, and any other desirable data. The paper cartons in which cartridges are purchased are convenient, but they often absorb moisture and cause the cases to corrode. Wood or cigar boxes are better.

Life of cases. Many cases can be reloaded an almost unbelievable number of times. We have frequently reloaded .30-06, .270, and .257 Roberts cases at least 25 times without noting any deterioration. Thin revolver cases that have to be crimped every time they are loaded do not usually last for more than 10 reloads. .220 Swift cases also have a rather short life.

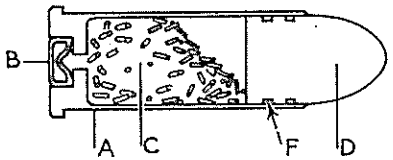
Cases wear out chiefly because a crack develops in their neck, because the primer pocket enlarges so it will no longer hold the primer tightly, and because the mouth of the case gets ragged and thin. Whenever a case shows any of these defects throw it away after hitting it with a hammer to avoid temptation at a future date. You only have one shooting eye!

Season cracking. When cases get very old the brass is liable to change its grain structure and become brittle. Then the case may develop a crack or split, usually a longitudinal split in the neck. This crack may occur in the loaded cartridge, in the case while loading, or when the cartridge is fired. Usually this is not at all dangerous unless the split occurs down close to the base of the case (which it hardly ever does). But, of course, a cartridge that cracks before firing is unserviceable, and one that cracks during firing usually means that the bullet does not hit the bullseye. Cases seldom crack in this manner until they are about ten years old, and this is about the only way that cartridges deteriorate with age.

In the days of black powder we had to wash our cases after every firing because the fouling would corrode the brass badly. But the smokeless powder fouling inside a case does no harm to it, and it is neither necessary nor



RIMLESS, NECKED RIFLE CARTRIDGE



RIMMED, STRAIGHT RIFLE OR PISTOL CARTRIDGE

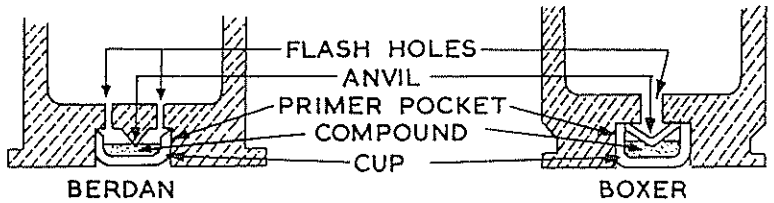
NOMENCLATURE OF METALLIC CARTRIDGES

A. Case.
B. Primer.
C. Powder.
D. Bullet.
E. Shoulder of case.
F. Lubricating groove.

1. Diameter of rim.
2. Diameter at base.
3. Diameter at shoulder.
4. Diameter at neck.
5. Max diameter of bullet.
6. Overall length of case.
7. Overall length of cartridge.
8. Length of neck.
9. Angle of shoulder.

desirable to wash fired cases before reloading them. In fact washing cases rather predisposes to season cracking.

In some cases where the necks are badly powder marked it may be desirable to remove these marks. A rub with a cloth soaked with any one of the light machine oils will help. If cases are very dirty a good scrub with steel wool might be helpful, especially as cases with dirty exteriors tend to bind in the chamber. If it is desired to go all the way and clean up the cases to factory freshness they should be soaked in a jar containing ordinary white vinegar and thoroughly washed and dried.



If the weather is bad and ordinary drying in the sun is not possible, the cases may be dried in an oven. Stretch a sheet of newspaper under them and set the oven to 150 degrees and leave the oven door ajar. If the oven is set higher it will heat the cases and char the paper. The use of excessive heat hastens season cracking, and will markedly shorten the life of cases. It is not the washing that spoils the cases, but the quick-drying process using excessive heat. Once the oven heats up turn it off as it is your most expensive and least fool-proof item you are monkeying with.

Too much heat can even ruin cases completely, and since it is only a thin brass shell that stands between you and thousands of pounds pressure of gas at a couple of thousands of degrees it does not pay to give your cases the acid and heat treatment too often.

SELECTING A CARTRIDGE

While it is appreciated that at this stage of the game you have already purchased your rifle and cartridges with it, it is nevertheless of value where reloading is concerned to pick a case shape and capacity in the cartridge as some reload more readily than others.

The .22 Hornet has enjoyed a reputation since 1934 of being a very good small game cartridge. This reputation has been earned in the game field, but the Hornet is not a very versatile cartridge in that it offers only one or two bullet weights and the choice of powder is again very restricted. Should it so happen that you are unable to buy your favorite brand of powder, of which there are only one or two suitable on the market, then you are in a situation where your rifle is of little use to you.

Furthermore, the Hornet is distinctly 'choosy' about the loads it digests, and so is not what we might call a versatile cartridge.

The .218 Bee offers few of the problems of the Hornet as, while there are only three or four powders available, fair results can be obtained with virtually any load tried.

The .222 Remington offers a good choice here as it will burn most of the faster powders available, and most of the medium range powders, with excellent results. Yet at the same time it can be reloaded back to Hornet ballistics.

It is advisable therefore, when purchasing a rifle, to consider this question of what powders are available, the common one being 4740 on our market, and to select the cartridge of sufficient capacity so that supplies of powder will always be readily available.

With this point in view, the cartridge selected should be between 25 and 50 grains capacity, which will handle 4740 well at the bottom end of this range and 4831 equally well in the 45-50 grain class.

This covers most sporting cartridges which are suitable for the light thin-skinned game in Australia, and yet will kill deer when cartridges are in the top edge of this bracket.

Another factor affecting the choice of a cartridge is its shape. The flanged or rimmed cartridges are ideal for the 'wildcatter'. The rimmed case, together with its belted counterpart, gives positive head spacing at the back of the chamber. Furthermore, both give complete gas seal and give more than adequate support to the primer pocket. The reloader is not dependent on the body of the case holding should he make a mistake in his loading.

The rimmed or belted case will hold in a loading that will destroy a rifle using a rimless case. The chamber can be badly bulged and yet the gas is kept away from the shooter's eyes and the locking lugs of the rifle.

The belted case offers marked advantages over the rimmed case in that it feeds much more readily through a magazine without any special placing of cartridges in the magazine. This is the reason why it has become a first choice of the larger cartridges which are used on dangerous game in the magazine rifle. Typical examples of this are the .375 Holland & Holland, the .458 Winchester and the .358 Norma magnum, all of which are used on dangerous game. #

CHAPTER FIVE

Chamfering, Decapping, Neck Sizing

FACTORY loaded cartridges have the mouth of the case crimped into a cannelure in the bullet to hold it firmly in the case, and when they are fired, some of this inturned crimp remains. New primed cases that have never been loaded or fired have a square edge, almost a scraping edge, at their mouth. In both instances, if we try to seat a bullet in a case, the base of the bullet, instead of entering smoothly inside the neck, often tends to hang up on this sharp inner edge of the mouth, and the pressure crumples the neck of the case, ruining it. To avoid this, we should slightly bevel or chamfer the inside of the mouth before reloading it for a box magazine or single shot rifle. This is easiest done with a small chamfering reamer furnished by most makers of loading tools as an extra to their outfit.

A simple, useful substitute is a 60 degree counter sinking bit readily obtainable at any hardware store.

The reamer simply is run into the mouth of the case, turned around about two revolutions, and the job is done. Do not overdo it, you want just a barely discernible bevel. Or the job can be done by a careful man with a sharp pen-knife. After chamfering each case, tap the mouth of the case lightly on the loading bench to see that no small shavings of brass remain inside the case.

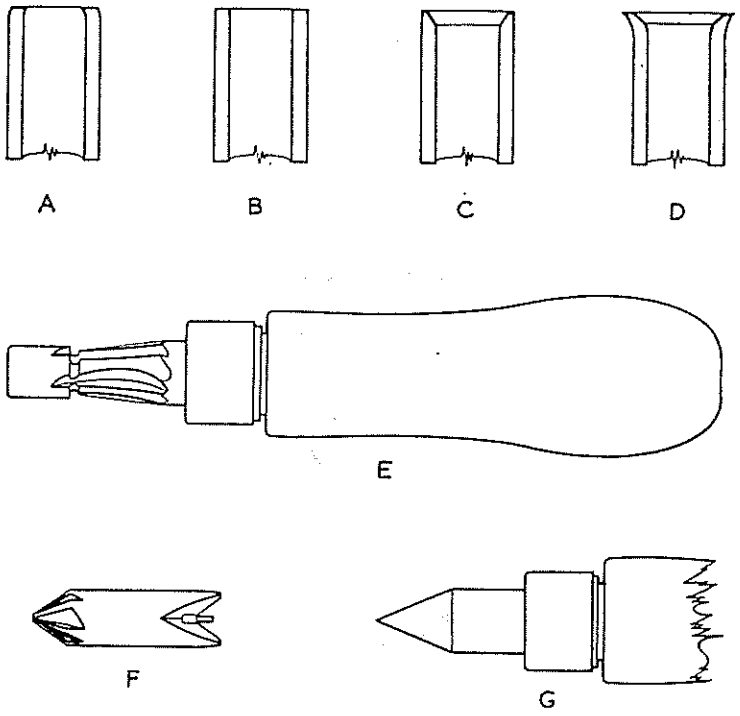
This chamfering of such cases for use in box magazines and single shot rifles, where the case is never going to be crimped again, has to be done only once before it is first hand-loaded. It is well to do it as soon as convenient after the cases have been fired, and then to note on the slip of paper in the box that contains those cases the word "Chamfered". A typical slip in one of my boxes of fired cases says, "Fired in Rifle No 1320, chamfered, necks resized for metal cased bullets."

Cases for tube magazine rifles and revolvers. When cartridges are hand-loaded for rifles with tubular magazines, the cases must be crimped onto the bullets each time to prevent the bullets being driven deeply into the necks of the cases by spring pressure plus recoil as they lie in the tubular magazine.

Revolver cases must be crimped on the bullets to prevent them moving while the cartridges lie in the cylinder during firing, and also to offer sufficient initial resistance to cause the quick burning powder to generate proper gas pressure. If we were to chamfer or ream the mouths of these cases each time we hand-loaded them, pretty soon we would have a knife-sharp edge to the mouth, and then we would gradually wear the case shorter.

Instead of chamfering or reaming the mouths of these cases we slightly bell-muzzle them with a smooth cone-pointed tool which can be easily made. Or when we use the neck resizing die, we screw it just a little farther into the tool so the shoulder at the top end of the primer ejecting rod will slightly bell-muzzle the case as we resize its neck. The bell-muzzling should be done after the case has been neck resized and before the powder charge is placed in it, and should be done only enough so that it can just barely be felt by the fingers. Then, when the bullet is seated in the case, the crimping shoulder in the bullet seater reverses this bell-muzzle and turns it into a crimp on the bullet.

Ironing revolver cases. The Pacific Gunsight Company produces an Inside Shell Ironer. This is an inside expanding die, which is run into a pistol case after it has been neck resized. It expands the inside of the case



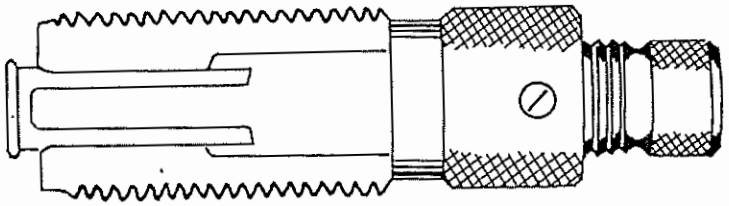
PREPARING THE MOUTH OF THE CASE

A. Fired factory case showing remains of crimp.
B. Newly primed case showing square mouth.
C. Chamfered mouth ready for reloading for bolt action and single shot rifles.
D. Bell-muzzled mouth ready for reloading for tubular magazine rifles and revolvers.
E. Chamfering reamer with pilot for one particular calibre of case.
F. Universal chamfering reamer for all calibres. The right end is for smoothing the outside of the mouth when necessary.
G. Plain smooth steel cone for bell muzzling.

to exactly the right diameter to hold the bullet, smooths up the inside of the neck, and properly bell-muzzles the mouth of the case. It contributes considerably to the preparation of accurate and dependable handloaded revolver ammunition.

Automatic pistol cases. With few exceptions self-loading pistols and a couple of rifles such as the .351 and .401 Winchesters (self-loading), use straight rimless cases. These cases have no shoulder as do bottle-necked rifle cases to hold them to the proper depth in the chamber and to give them proper headspace. Instead they depend upon the square mouth of the case abutting against the square end of the chamber to hold them in the proper headspace position, and against the blow of the firing pin. Therefore the square mouth of these cases should be left as it is and never disturbed by chamfering or bell-muzzling. Simply neck resize the case and then expand it inside to hold the bullet friction-tight.

Lead alloy bullets for these cartridges should have their base very



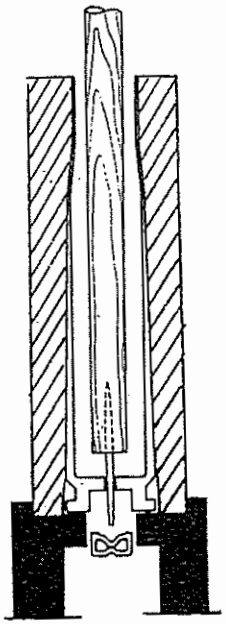
Shell Ironer.

slightly bevelled so they will enter the case without hanging up or shaving.

Where the muzzle velocity is around 1200 fs or above, the deep-base Harrison style gas-check or factory "half-jacketed" bullets are preferable. They can be cast fairly soft, say one part tin to 15 parts of lead, and still be given velocities up to 2000 fs. Such a bullet will expand and cut a wound channel one third as large again as a very hard bullet cast one part tin to ten parts of lead.

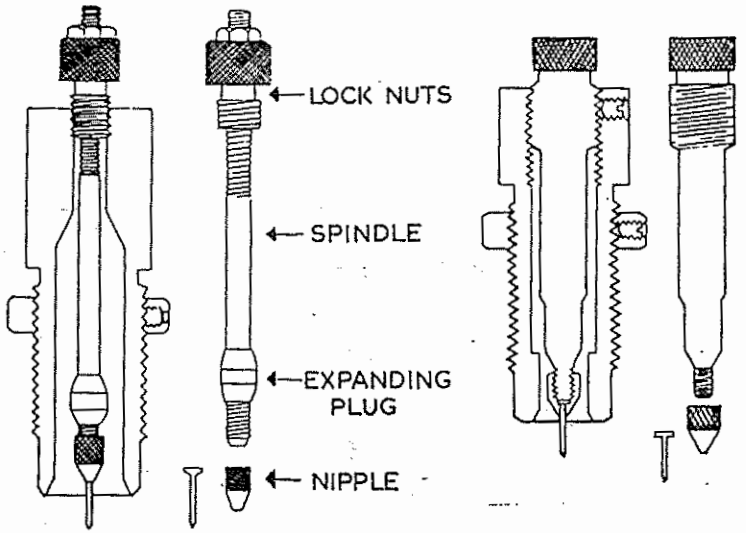
DECAPPING AND NECK RESIZING

The second and third operations on the fired case are decapping and neck resizing. Many reloading tools do these two operations with one throw



A simple decapper. Simple bullet seaters are also made on same design, a seating plunger replacing primer pin stem.

of the operating lever, or one passage of the case through the die. But it will be clearer to describe the two operations more or less separately.



Resizing Die.

Decapping is usually done in the resizing die of the reloading tool. There is a primer punch inside the die and when the case is forced into the die during the resizing operation this punch enters the case and punches out the old primer. Or it is easy to make or buy a decapping punch and a base that can be used separately from the reloading tool.

Take a piece of steel drill rod about 5 in. long that will just enter the neck of the case freely. Drill a small hole in one end and drive in a blunt pointed steel pin about .06 in. diameter so that it projects about a half-inch beyond the rod as shown. A slightly blunted phonograph needle makes a fine pin. Alternately, any machinist can turn a small end on a piece of correctly sized tool steel if you give him a de-capped case, at almost nominal cost.

Make a base to hold the head of the case when you drive the primer out. A cylinder of brass or hard wood, countersunk slightly to take the head of the case with a $\frac{1}{4}$ in. hole drilled clear through it in the centre of the countersink is fine. Place this base on the loading bench, place the head of the case in the countersink, insert the decapping punch in the mouth of the case, feeling carefully so the pin enters the flash hole. Tap the end of the rod with a hammer, and the primer will be driven out and fall into the hole in the base. When the hole in the base is filled with primers, dump the old primers into the wastebasket.

This simple method of decapping is convenient to use in the field away from tools, and may also be desirable when you have not decided whether you wish to resize the necks of those cases for metal cased or lead alloy bullets. These two types of bullets require the necks of the cases to be expanded to a slightly different diameter.

Neck resizing. When a cartridge is fired in rifle or pistol, its neck expands to the diameter of the neck of the chamber in the weapon, which is usually about .003 in. larger than the neck of the loaded cartridge. As a consequence, the neck of this fired case is so large that the new bullet, if seated in it, would not remain firmly in the neck but would either fall out or would fall down inside the neck on top of the charge of powder. So the neck must be resized smaller by forcing it into a resizing die.

The inside diameter of the neck of the resized case is very important because for good accuracy the bullets should be held with a certain uniform tension. Powder gases build up to a high pressure in a cartridge when the bullet is tight in the neck, and to a lower pressure when the bullet is held loosely, and the accuracy suffers. Brass cartridge cases are drawn in dies during manufacture, and not turned accurately in a lathe, and consequently the thickness of the neck walls is not uniform.

Thus we cannot get a uniform inside diameter by simply resizing the outside of the neck of the case. For this reason the best practice, for which almost all tools are adapted, is to resize the necks of the cases in a die which makes them about .002 inch smaller inside than necessary, and then expand them to the exact inside diameter by pulling or forcing an expanding plug through the inside of the neck.

A cross section of the usual rifle and pistol resizing die is shown in our illustrations. The die has a combined decapping pin and expander screwed into the centre of its cavity. Let us say that our case is one of .30 calibre, and that it has been expanded by firing so that it measures about .311 in. inside neck diameter. We wish to resize and then expand this neck to about .307 in. inside so that it will hold a normal .30 calibre bullet measuring .308 in. in diameter.

To do this we use a decapping rod inside the die which has an expander plug or swelling on it that measures about .308 in. This expander passes through the resized neck as we withdraw the case out of the die, and enlarges the neck to .308 in. The case springs back slightly after the expander has passed through it, so that the neck then measures about .307 in.

Now let us see how the die shown in the photo on page 15 works. Suppose we force a fired case into this die by means of the lever and the case holder of the reloading tool. The case slips freely over the decapping rod-expander because its inside neck diameter is slightly larger than the rod.

The case slides on until its mouth enters the neck at the upper end (or bottom) of the die. As the case neck is forced into the die neck it is reduced in diameter. At the same time the decapping pin has entered the flash hole of the case and has driven out the fired primer.

Now reverse the motion of the lever of the reloading tool and the case is drawn out of the die. Its neck has now been sized down so it is smaller than the expanding plug, and as it is drawn over this plug the neck is expanded to its correct inside diameter.

For pistol cartridges with straight cases, like the .38 S & W Special, .44 S & W Special, .45 ACP, and .45 Colt Revolver cartridges, three dies are advisable. The first straight resizing die resizes the fired case to correct outside dimensions. Then it is run into a resizing and neck expanding die which expands the inside of the neck correctly for the diameter of the bullet, a shoulder on the upper part of the expander plug slightly bell-muzzles the mouth of the case to permit seating the lead bullet without shaving, and the old primer is ejected. The third bullet seating die seats the bullet and crimps the case on it.

Adjusting resizing dies. At the start of the resizing operation it will be necessary to adjust the die correctly in the reloading tool. Screw the die part way into the tool. Try forcing a lubricated case into it. If the die does not resize the neck its entire length keep screwing the die farther down the tool until it does. You can easily tell how far down the neck the die is resizing by the marks of the lubricant on the neck.

Never screw the die into the case so far that the die will compress or shorten the shoulder of the case. That would reduce the headspace dimension of the case and might introduce a dangerous condition. The die usually has a stop collar on it.

When the die has been correctly adjusted screw this stop collar down until it touches the frame of the tool, secure it, and thereafter merely screw the die on to the tool up to the stop collar and it will be in adjustment.

In tools where the primer is removed, it pays to check as the neck is resized that the decapping pin is forcing the primer out by adjusting it after

the neck sizing adjustment has been set. As soon as the tool is set so that the neck is sized down far enough — and this should be at the point where the handle comes against the frame — the decapping pin should have the lock nut loosened and the shaft screwed down from its partially retracted position until it just comes into contact with the inside of the base of a decapped case. A check now with fired case should remove the primer and outside neck-size the case with the lever of the press moved until it stops against the frame. On the return stroke the case should be inside neck-sized.

Ordering neck resizing dies. If you are going to handload cartridges with metal cased bullets only, order your reloading tool for the particular cartridge you wish, and specify a "neck resizing die and expander to resize case necks to hold metal cased bullets friction tight." If, in addition you are going to load lead alloy bullets order "an extra decapping rod and expander to expand case necks to — inch inside to hold lead alloy bullets friction tight." This second expander will be from .001 in. to .003 in. larger in diameter than the one for metal cased bullets.

Lubricating cases. You must never try to force a dry case into a resizing die. If you do, the case will "freeze" in the die, you can not get it out, and the die will have to be sent back to the reloading tool maker to have the brass case removed. Always lubricate the outside of each case before it is forced into the die. The inside of the case neck must be lubricated also so it will slide easily over the expander plug.

On the outside of the neck you can smear on a light coat of oil or grease, not too heavy or it will cause the neck to buckle or dent. The best lubricant I have found for this purpose is anhydrous lanolin. You can buy a small jar of it from any chemist for a few shillings. Four ounces will suffice for many thousand cases. Or some loading tool makers supply their own grease that we don't know is any better. Anderol do market an excellent one, while Norma suggest the use of an ordinary stamp pad soaked with neatsfoot oil over which cases are rolled preparatory to sizing.

One good method of applying lubricant to cases is to have the jar of lanolin and the pile of cases on the bench to the left of the loading tool. Anoint the thumb and forefinger of the left hand with the lanolin. Then take a case in the right hand and rotate the outside of the neck through the lanolin-covered thumb and forefinger, thus smearing a light coat on it.

If the case is to be neck resized only, the grease need be smeared on only down as far as the shoulder. But if you are using a full-length resizing die the grease must be smeared over the case almost down to its head or it will soon stick in the die. Then run the case through the resizing die with the right, ungreased hand.

Now once in about every five cases, as you smear the neck with lanolin, draw your forefinger squarely across the mouth of the case, resulting in smearing a very small edging of grease on the inside edge of the mouth of the case. This will keep the neck expanding plug lubricated enough so that the case will slide easily over it as you withdraw it from the die. If you get just a slight suspicion of grease on this inner edge of the mouth it will be sufficient for the purpose.

If you get too much on you will have the inside of your case necks greased, and you will have to wipe them out afterward with a small rag on a stick, for you don't want any grease here when you come to pour the powder in and seat the bullets.

While the lanolin technique is a highly satisfactory one for the colder areas, grease inside cases may cause trouble through some of it running down into the case and causing the powder to be a trifle oily.

Another side effect where Continental style flake powders are used is for the powder to stick to the sides of the neck of the case and cause trouble when the bullet is being seated.

An alternative and preferred technique where there is the slightest doubt about problems of oil in the case is to buy a small container of air-floated

graphite which has very fine particles indeed. This is readily obtainable from any service station or engineering supply shop. Just dip the case into the graphite up to the shoulder, bump the case on one side of the container to make sure that an accumulation of the fine powder isn't filling the neck of the case, and then decap and resize the case.

This technique has the advantage of not getting oil into the case, and of lubricating the neck on both inside and outside surfaces. Furthermore after the dies have had a little of this treatment they will give much better results than with ordinary lubricant as the graphite forms a fine film over the rubbing surface. The graphite will leave a mark on the case neck similar to a powder stain, but a wipe with a cloth slightly dampened with methylated spirit will make the case look like new.

In any event, make sure no oil or graphite gets on to the body of the case as this could markedly increase thrust on the base of the bolt, and in one of the weaker actions like the Lee Enfield the consequences could be very serious and completely destroy the action, by blowing the bolt out of the bolt way.

In neck resizing, it is not necessary to resize the full length of the neck of the case. In fact, it is better to resize the neck only down as far as the seated bullet extends down, as often better accuracy is obtained in this manner. You adjust for this according to how much you screw the resizing die into the reloading tool.

When all the cases have been resized in the above manner, take a rag and wipe all the grease off the cases. The cases are now ready for the next operation of repriming, unless enough fouling has accumulated in the primer pockets to make it necessary to clean them.

Cleaning primer pockets. A hard residue of primer fouling tends to accumulate in the bottom corner of the primer pocket. Enough may gather to prevent the new primer being seated to the correct depth; that is, clear to the bottom of the primer pocket. Then the primer would extend out beyond the surface of the head of the case and it might be struck and ignited in handling, or the rifle bolt might crush the primer, either causing it to fire, or possibly powdering the priming pellet so it would not fire properly. Or the fouling might cushion the primer against the blow of the firing pin, causing a misfire or a hangfire.

Watch this accumulation of fouling in the bottom corners of the primer pocket, and if it causes any difficulty whatever in seating the new primer, clean it out. We have had but little trouble from this source and have not had to clean primer pockets more than about once in five loadings, but it is a condition that must be watched.

It is easier, however, to safeguard against this problem arising. It is very easy to clean out primer pockets after the cases have been used rather than let an accumulation of fouling build up. All it needs is a touch of pressure from any pointed surface and the primer deposit will crack and drop out. Allowed to accumulate, then it becomes correspondingly hard to move. A useful tool is made from a screwdriver, the blade of which has been filed to exactly fit the bottom of the pocket, and with a scraping edge. Don't scrape so hard as to remove any of the brass.

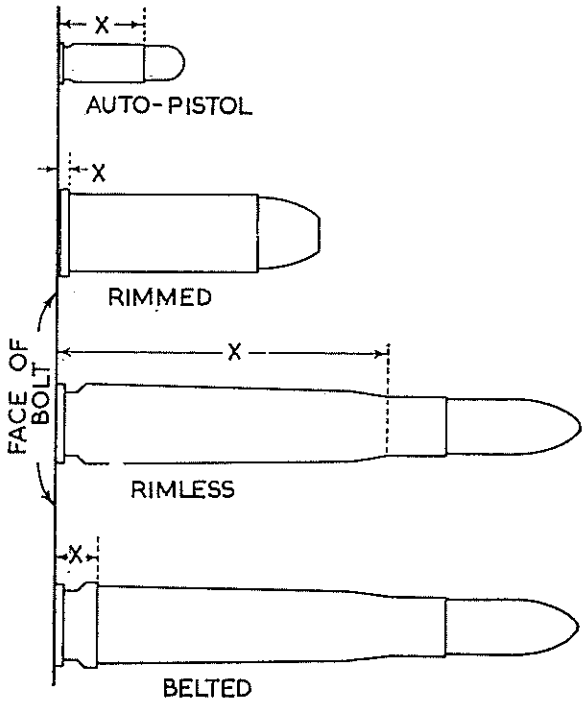
Flash holes. When reloading fired cases for the first time, examine the size of the flash holes in the bottom of the primer pockets. If the hole appears to be appreciably larger or smaller than normal, destroy that case. These flash holes are made the exact size to properly ignite the powder.

If larger or smaller than standard the result will be poor ignition and poor accuracy, or more serious, blown primers and gas blowbacks. Therefore never attempt to alter the size of flash holes. It is interesting to note that one of the causes of misfire in factory ammunition is a case with no flash hole at all. You don't find more than one flash hole defect in 10,000 cases, but it is one of the things to watch in trying to load super-accurate and dependable ammunition.

Military cartridges loaded in government arsenals, or loaded by com-

mercial ammunition companies under government contracts, have the primers crimped in the primer pockets so there will be no danger of their popping out and clogging the mechanism of machine guns and automatic weapons. It often happens that handloaders fire these cartridges in practice, or they may pick up a supply of them on government target ranges, and wish to reload them.

The primers in these cases are very hard to punch out. Trying to do



In the sketch shown, "X" is the headspace dimension. With rimmed and belted cases, it is the distance in the rifle from the face of the bolt to the shoulder in the chamber against which the rim or front of the belt on the head of the case rests. In a cartridge, it is the thickness of the rim or the thickness of the belt. This dimension depends upon the tolerance allowed in the manufacture of the cartridge cases.
Generally speaking, the minimum headspace is the maximum allowable head or bolt thickness in the case, and the maximum allowable is about .004 in. greater than this. We seldom or never run into any headspace difficulty with rimmed or belted cases. All you have to do is to screw the full-length resizing die into the reloading tool, resize a case in it, compare that case with a standard factory-loaded cartridge, and adjust the tool until the shoulder of the resized case appears in exactly the same position as the shoulder on the factory case. When it does, try the resized case in your rifle. If it requires quite a tug on the lever or bolt handle to close the bolt on the head of the case, the die should be screwed just a little tighter into the tool until it requires just a barely perceptible tug or pressure on the lever or bolt handle to seat the case in the chamber and close the bolt. Then screw up to the stop collar on the die and go ahead and resize your lot of cases.

so with the standard primer extractor pins usually bends the pin. A much stronger pin is necessary. Also when the primer has been removed the primer pocket has much of the crimp remaining in it, and a new primer cannot be inserted until this crimp has been removed. There are special tools for removing these crimped in primers and primer pocket crimps and it pays to buy them. Some of the tools for removing the crimp in the pocket ream it out, and some press it out. I rather think that the latter is the better practice.

Apart from the difficulty of removing the single flash hole primer when it has been crimped in, a fresh complication appears when Continental or Berdan primers have to be removed — as with .303 British service brass, .310 Cadet, 7.63 mm Nato, older ICI brass in Hornet, and virtually all their heavy cartridges, some .243 and all revolver and pistol cartridges.

There are several techniques, one involves filling the case with water and then with the case supported by a die inserting a plunger into the case neck and punching the primer out by smacking the plunger a smart blow with a mallet. It does not have to be heavy, just quick.

The case then must be dried out, and if heat is used, this hastens split case necks as it accelerates season cracking. Some use petrol instead of water and this will evaporate off leaving a thin oily film behind, which under some conditions will cause added thrust on the bolt and also darkens the outside surface of the case on firing.

A side effect is a slight roughening of the case after firing which makes extraction a trifle more difficult and can slow down the speed of operation of lever and slide action arms.

A better method is to buy one of the plier type decappers which nip out the primer with a small curved blade and are the most satisfactory method of removing these primers. Another technique is to drive the case into the neck sizing die and with the die firmly held in a vice to use an old .303 striker with the point filed to a chisel edge. Drive it into the primer cup at the side to avoid damaging the anvil, and then give another tap of the hammer to move it well under the primer, then flick the primer out with a quick upward movement.

By the same token when dealing with crimped in boxer primers, a decapper made up by a machinist from tool steel can be used in conjunction with a full length sizing die. This removes the primer and the case from any one of the necking down dies. It is best done at the first stage as sometimes primers explode when a case is being removed from a die due to the impact of the punch against the inside of the case. This is especially applicable to the use of .30 cal Springfield brass used to make .25 Neidner or the .25-06 Ackley cases.

So far we have considered only *neck* resizing of cases to be used again in *the same bolt action or single shot rifle in which they were originally fired.* It is best to resize the necks only of such cases because their bodies and shoulders have been accurately expanded to fit the chamber of the rifle in which they are to be used again. But there are two types of fired cases which need full-length resizing to restore their original outside dimensions and shape.

Firstly, cases that have been fired in rifles other than the one in which the reloaded cartridge is to be used. The chambers of various rifles of the same calibre differ slightly in their dimensions, and a case fired in one rifle may not exactly fit another.

Cases collected from various places should be segregated according to make (stamping on the head) because cases of the same calibre but of different makes do not always have the same wall thickness or inside capacity. The pressure and velocity will differ slightly in each make, and they may not shoot to the same centre of impact with an identical load.

Secondly, cases that have been fired in lever or pump action or semi-automatic rifles. There is a slight spring back to the breech block when these rifles are fired which permits the case to expand in length. This expanded case, if reloaded without full-length resizing, probably could not be again loaded into the rifle which fired it without using prohibitive force

to close the breech. As a consequence these cases have to be full-length resized even for use in the rifle in which they were originally fired.

Different types of full-length resizing dies. Considerable force has to be applied to push a case into a full-length resizing die, and to pull it out of the die. There are certain light models of reloading tools with which this force cannot be applied. If you have this type of tool you will have to buy a separate full-length resizing die which is operated by hand and not in the tool. Other stronger models of tools have full-length resizing dies which fit in the tool and are operated in exactly the same way as neck resizing dies. Because of this difference we will explain full-length resizing with each type of die.

Resizing with separate die. This consists of a cylinder of hard alloy steel bored and chambered inside to the correct dimensions and shape. A case forced into it will be resized practically to the same outside dimensions as the case of a factory-loaded cartridge. A punch to drive the case out of the die is also furnished. To use this die the case must first be coated outside *its full length* with a light coat of anhydrous lanolin and it is then inserted in the die.

Stand it on a firm bench with the case head up. Place a block of hard wood on the head of the case, and strike the block with a hammer or mallet, driving the case fully into the die, head of the case flush with the head of the die.

Reverse the die and hold it in the hand, insert the punch in the open end of the case, and while holding the die in the hand, strike the end of the punch with the hammer and thus drive the case out of the die. It is then necessary to neck resize and expand this fully resized case so that it will hold the bullet friction tight, and with proper uniform tension. It is best to neck resize at once while the case is still lubricated.

We do not recommend this method of hammering the case in and out of the die. We prefer to place the resizing die with the case stuck in it between the jaws of a large machinist's vice, jaws with copper covers, and squeeze the case into the die, then insert the punch and similarly squeeze the case out of the die.

Full-length resizing in heavy tools is done in exactly the same manner as neck resizing, the die being similar in adjustment and construction. Of course, here also, the case must be full-length coated with anhydrous lanolin as described earlier.

One very important precaution must be taken in full-length resizing. The resizing die must be screwed into the tool exactly the right distance so that it will resize the case to exactly the right headspace dimension. If the die is screwed too far into the tool, it will press the shoulder of the case back, giving a shortened case that would cause excessive headspace. And if the die is not screwed in far enough the case will be too long, head to shoulder, and probably will not fit into the rifle.

Some makers manufacture their heavy reloading tools, and the dies that they furnish for them, so that when the case holder is at its topmost position, the full-length resizing die should be screwed into the tool to meet the case holder, the cam action of the press over dead centre takes out the spring of the tool, and the case is resized just enough, including resizing, to correct headspace.

So full-length resizing in the reloading tool brings up the matter of headspace for consideration.

But before we leave this subject, remember that after you have full-length resized a case you still have to neck resize it to get the correct neck dimension to hold the bullet friction tight.

In Australia and New Zealand where a great deal of use is made of military brass due to the use of the SMLE action for construction of low-priced sporting rifles, there are a few special problems. The only locally produced bench tool, the Super Simplex lacks the power to full-length resize cases, and there are a great many hand tools made by local 'smiths

sold at the time of conversion of a SMLE rifle.

The .303 British case has been necked down to .224, .226, .243, .257, .270 and .280 according to the fancy of the 'smith and customer concerned. If military brass is used then two dies are needed for the calibres under .257 and one above. Since British brass is intended primarily for use in the service rifle it is somewhat stiffer than American brass, and will form more readily than American brass.

Where British brass requires two dies, American will need three. American brass will need an extra die where British brass will need one, if a sharp shoulder is used on the new case unless it is fire-formed in the new chamber.

An added complication arises with the use of once fired cases. These cases are usually fired in a service rifle and bought by the pound very cheaply from rifle clubs. Once the brass has been fired, it needs cleaning. This is usually done with an acid dip, and the cleaned cases then are washed and dried by heating them, they are then loaded by the various local companies and sold to the shooting public.

Often the cases split at the neck on re-firing, for the cleaning after the original firing accelerates season cracking. If unfired military brass is necked down reloaded and fired in the chamber of the rifle in which it is to be used, no trouble will occur, even should it be re-primed with the military copper colored primer. This applies equally well to the .243 Win cartridges which in some instances are made on re-loaded military 7.63 mm Nato brass brought from the military.

It is best to neck any brass down before firing whether it be .303, 7.63 mm or .30-06 Springfield. The additional working of the brass after firing by the resizing process invariably causes trouble, which shows up in cases that do not stand up to re-loading. Even with new brass fire formed in an improved chamber the degree of loss can be very high, as much as 80 percent from some makes. It all depends on how hard the brass is to begin with. #

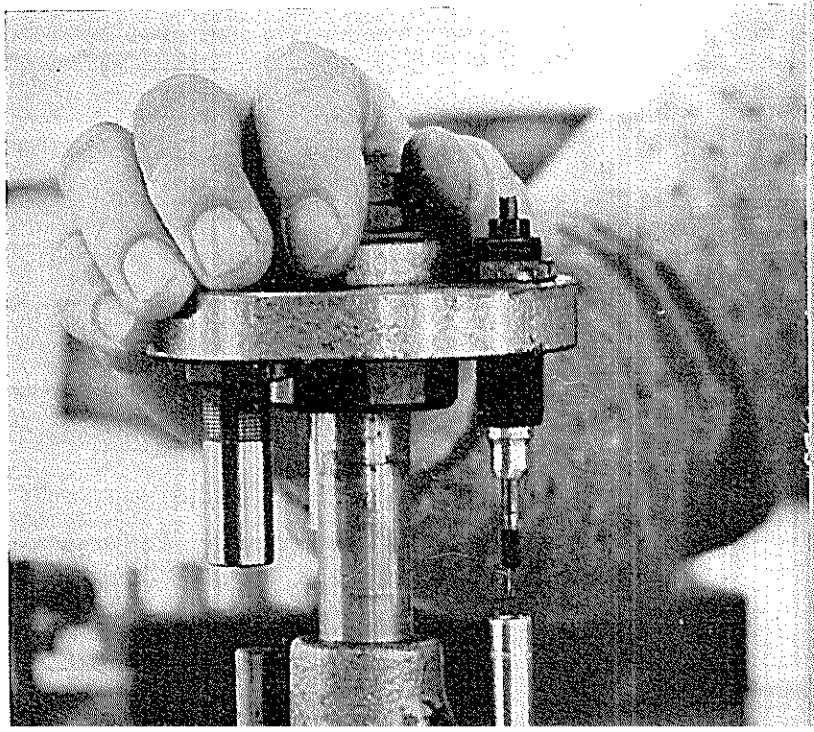
CHAPTER SIX

How It's Done in Pictures

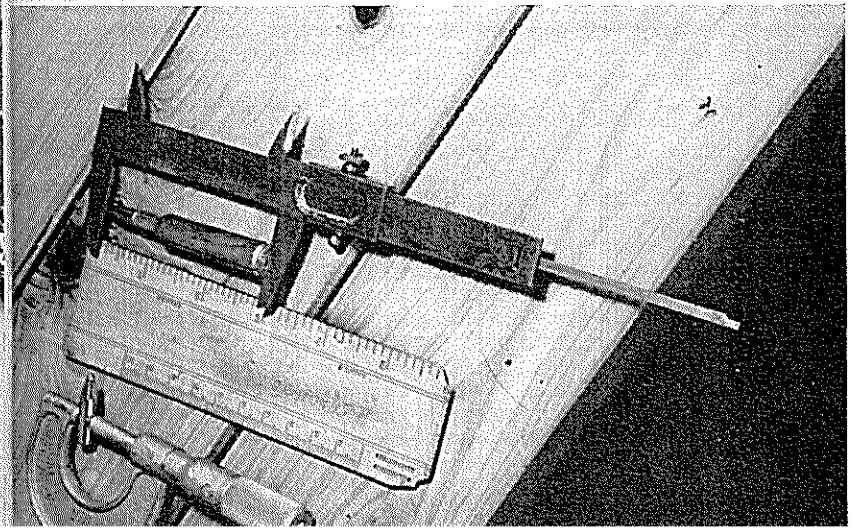
HANDLOADING is one of those pastimes in which good, sharp photographs showing an expert at work speak to the beginner with far more eloquence than the best-turned phrases. Thus we got Colin Shadbolt to set up all his reloading gear in the studios of Trenoweth-Colorcraft, where special lighting and cameras produced this superb array of photographs, perhaps the clearest ever taken of a handloader going through each of the basic steps involved in reloading a sporting cartridge. Shadbolt provided the captions, aiming himself primarily at the newcomer to handloading, but it is more than possible that much of what is shown here will be of value too, to old hands.

This is where handloading begins — the most expensive part of a cartridge, the brass case, is carefully retrieved after the rifle has been fired. Most suitable brass for reloading is the single flash hole type taking Boxer primers.

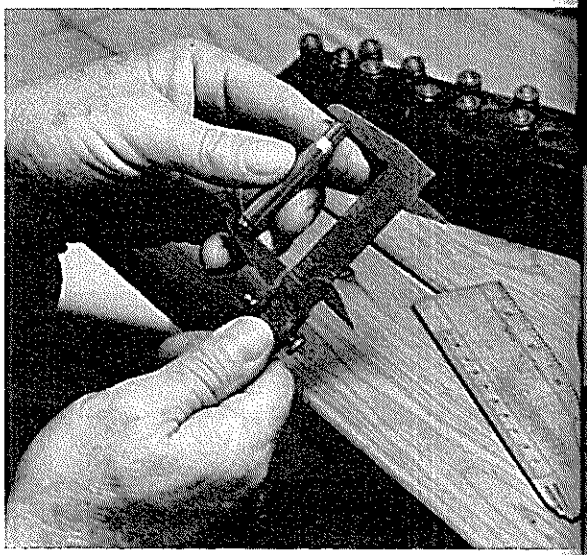
The case must be crimped on to the bullet for revolvers, and tubular magazine rifles, otherwise the shunting action in reloading will push the bullet into the case. In this picture, of a Super Simplex being used, the case is being decapped and the mouth opened to permit easy entry of a soft bullet and to remove the crimp, which doesn't shoot out.



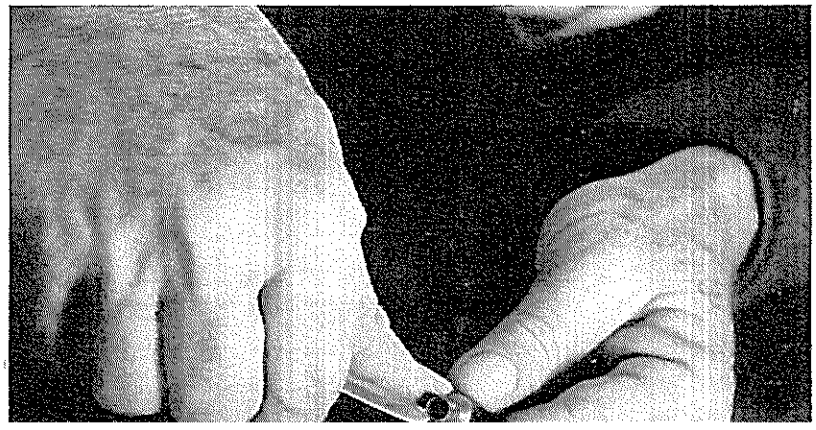
Three essential but cheap tools are a micrometer, a good boxwood scale ruler graduated in inches and millimetres, and inside and outside calipers. Before seating the bullet in the primed and charged case, the bullet diameter should be checked as nominal dimensions vary with the manufacturer. This is particularly the case with 6.5 mm and 7 mm projectiles. Loadings should be slightly reduced where bullets are found to be fractionally oversized or where very heavy jackets are encountered.

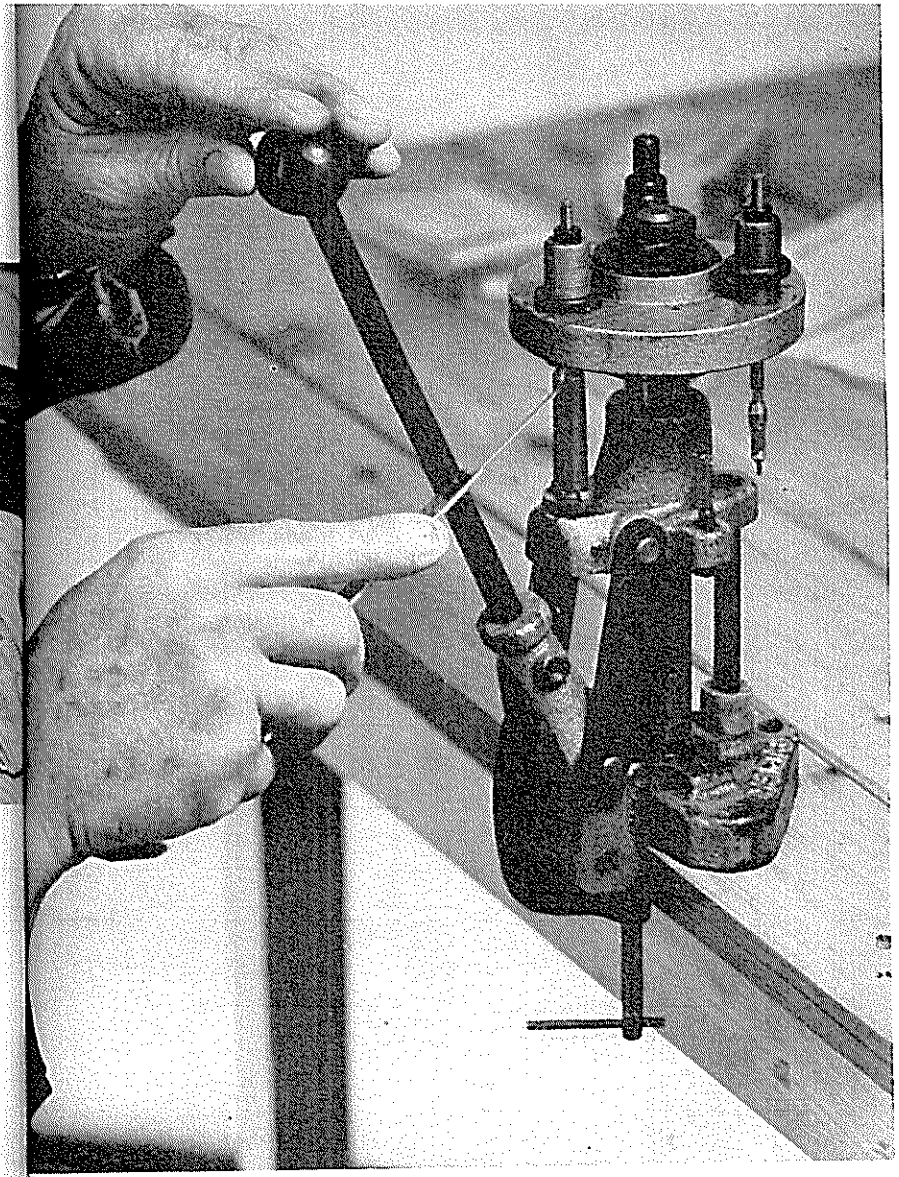


After firing, cases should be carefully checked with calipers to ensure that they have not lengthened due to brass flow. In modern cartridges where pressures are very high, there is a distinct tendency for cases with sloping shoulders, like the .243 Win. to lengthen. This raises pressures markedly for the case then projects into the lead of the barrel. At the time of this checking, the case neck is carefully examined for cracks or splits, which mean the case must be discarded. The base of the case should be examined to ensure there are no gas leaks around the primer pocket — which show up as small dark smudges around the edge of the primer pocket. Cases showing this defect should also be discarded, as otherwise the bolt face will be badly burnt. Should the case prove too long, it may be shortened with an ordinary file or with one of the special case trimmers now on the market.

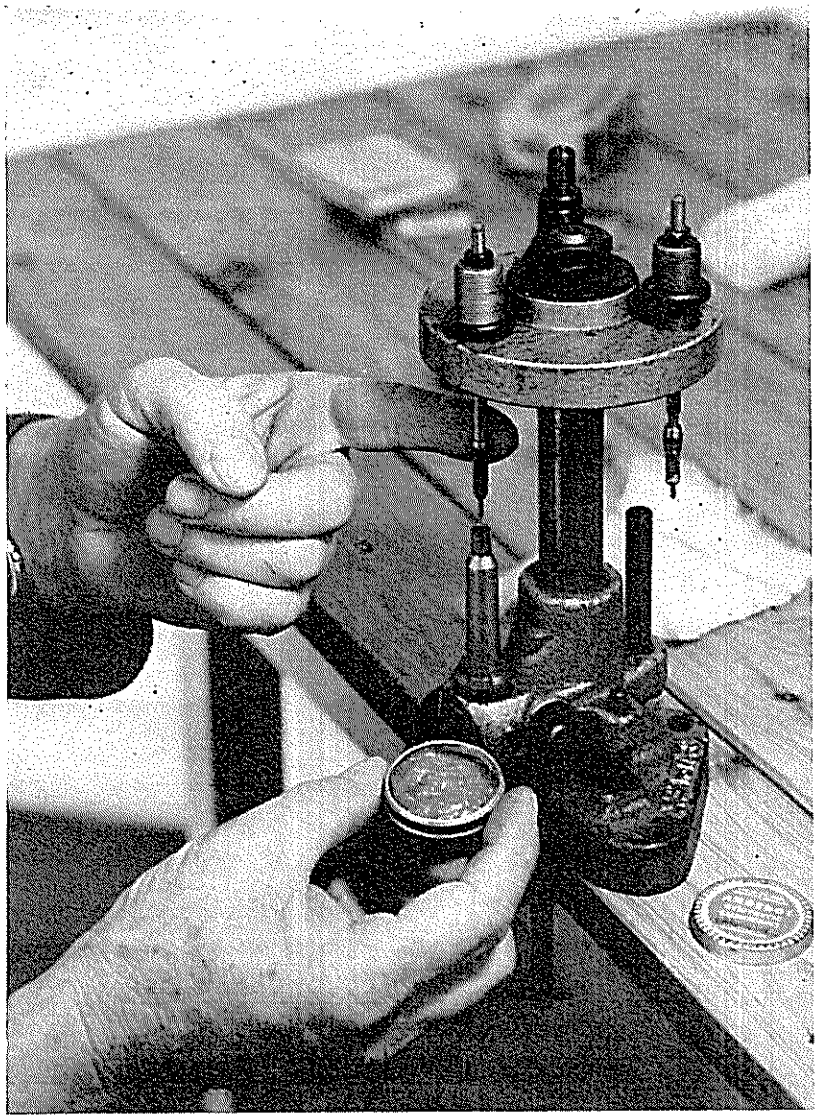


New brass, whether unfired or from factory-loaded cartridges, must also be chamfered at the neck. When the brass is cut by the factory machines it leaves rough edges which must be removed. This chamfering removes a tiny sliver of metal from the inside of the neck of the case, which allows the bullet to be seated easily without tearing or crumpling the case neck. For lead and gas check bullets, the case mouth must be slightly belled to avoid tearing pieces out of the side of the bullet. A more satisfactory tool than a knife is a 60 degree chamfering bit, readily available from any hardware store. This is only done once in the life of a case unless it has been shortened.



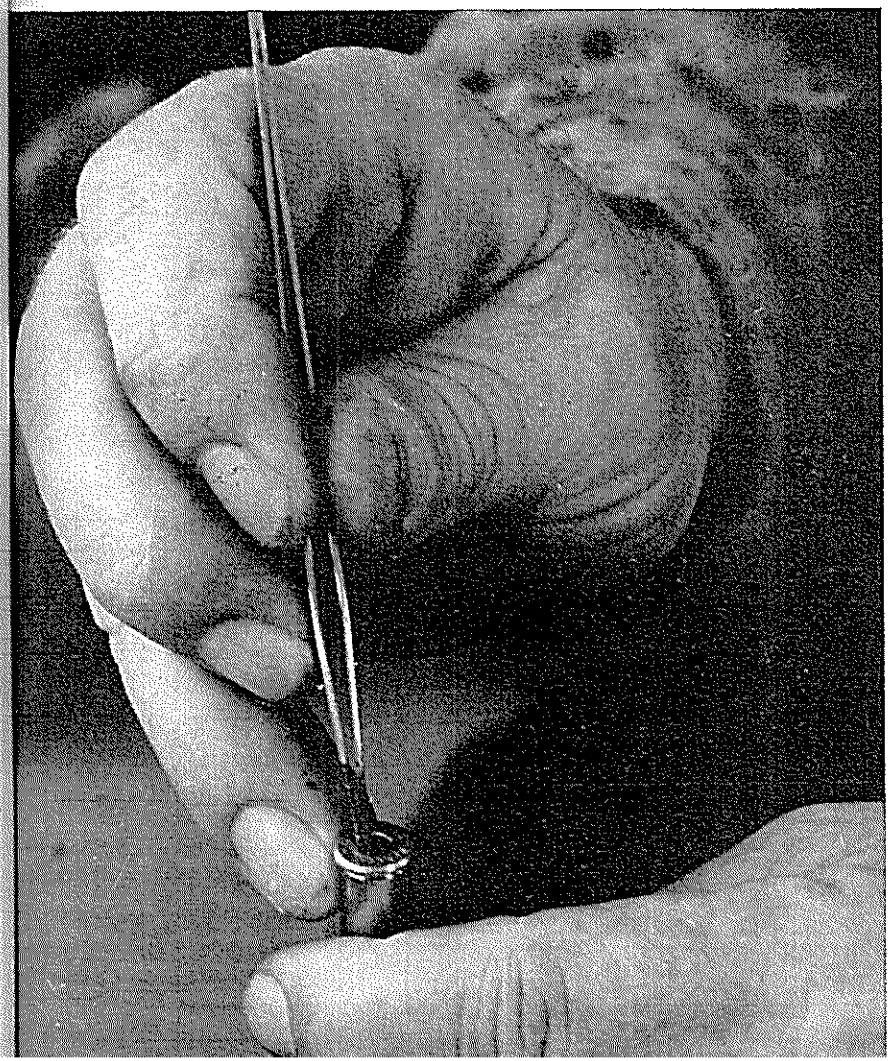


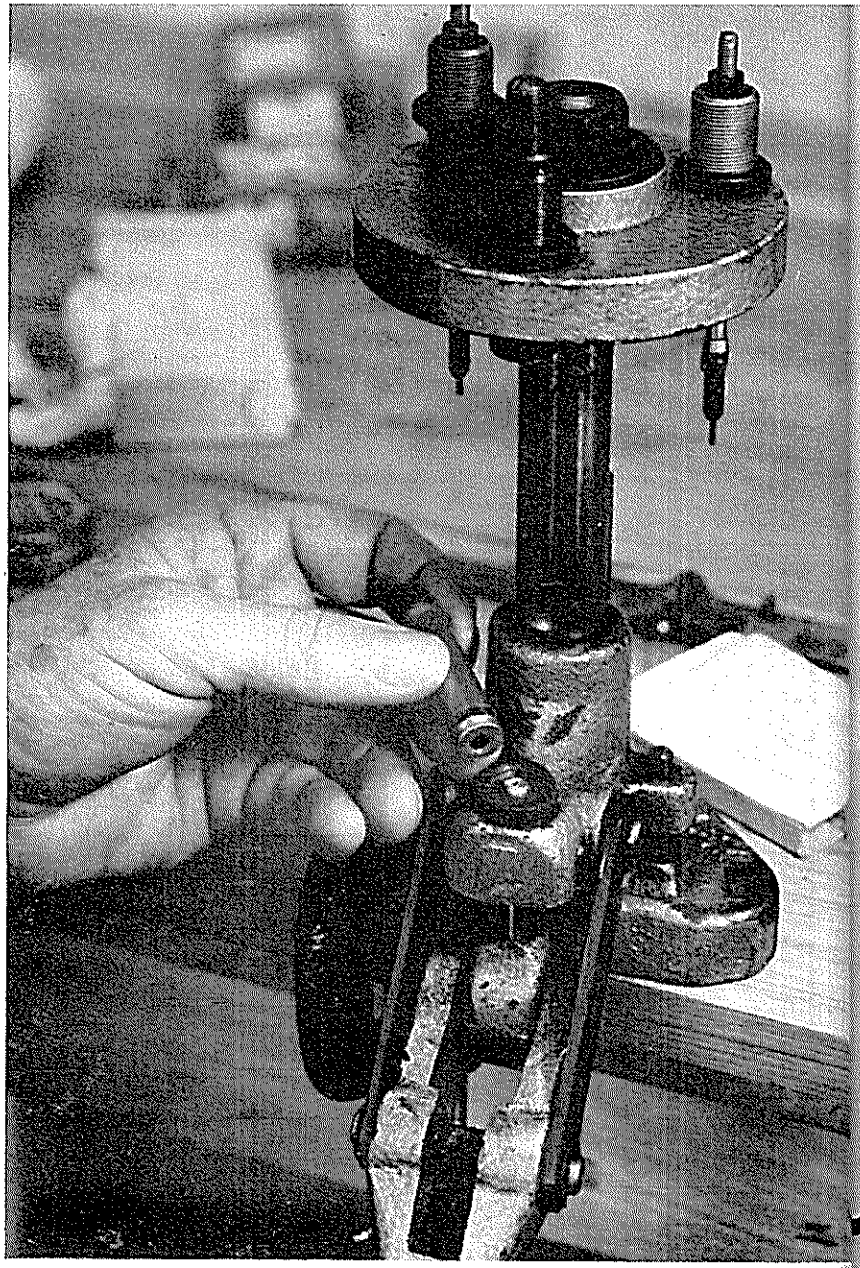
It will be noticed in this picture that the case is being decapped and the tool should be adjusted so that the lever strikes against the edge of the body assembly at the end of the stroke. In this picture attention is drawn with the end of the depth rod of the calipers to the shape of the case. If the shoulder is pushed back on the case, the headspacing is affected. Under the thrust of the striker hitting the primer, the case will be driven forward in the chamber. Excess headspace leads to separated cases and the gas at very high pressures will flood back through the action causing severe damage to the rifle and possibly the user. As a check against this, when headspace is in doubt the bullet should be seated out to contact the lands of the rifling as the cartridge is seated home in the chamber. Above all avoid lubricating the case which markedly increases back thrust and can cause separated lugs.



Using a bench-type tool, the case is neck-sized outside. As the lever continues down, it pushes out the primer. When the lever is pulled down, the case is inside neck-sized. This places considerable strain on the press and it is advisable to use a sizing lubricant like Anderol. This is applied to the inside neck-sizer and to the outside of the case neck. Considerable difficulty may be encountered in removing the primers from military brass as these are crimped into place. This crimp must be removed before a fresh primer can be seated. The simplest and most effective tool is a screwdriver, with a blade cut to .210 in. for large rifle primers. This is dropped into the primer pocket and turned until the crimping is relieved.

After the primer is fired some residue is deposited in the primer pocket. This is quite hard and if allowed to accumulate over a period it will prevent the full seating of the primer to its correct depth. It may be removed with a screwdriver blade of lesser diameter than the primer pocket. The primer pocket must under no circumstances be enlarged and primers which seat too easily into the pocket are the result of too high a pressure in the original charge for that make of case. Some brass may be too soft for a load previously used in that rifle and the load should be reduced. After several rounds have been fired in that particular case, the brass will harden and permit a return to the higher loading. Enlarged primer pockets must be taken as a danger signal of too high a pressure. Irrespective of the apparent appearance of the primer the enlarged pocket is the final warning.



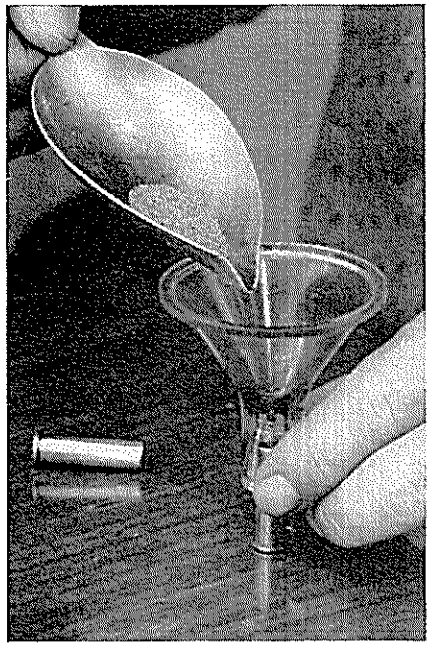


This tool, unlike the American tools lacks a primer feed. The primer must be dropped into the whole of the shell holder, ensuring at this time that the cup is up. Should the primer be seated in upside down, a misfire will most certainly result. The primer should be seated with a firm even pressure so that the face of the primer is fractionally below the base of the shell. Should too much pressure be used, the priming compound will be cracked. This leads to misfires and hangfires. A hangfire is a delayed primer explosion.

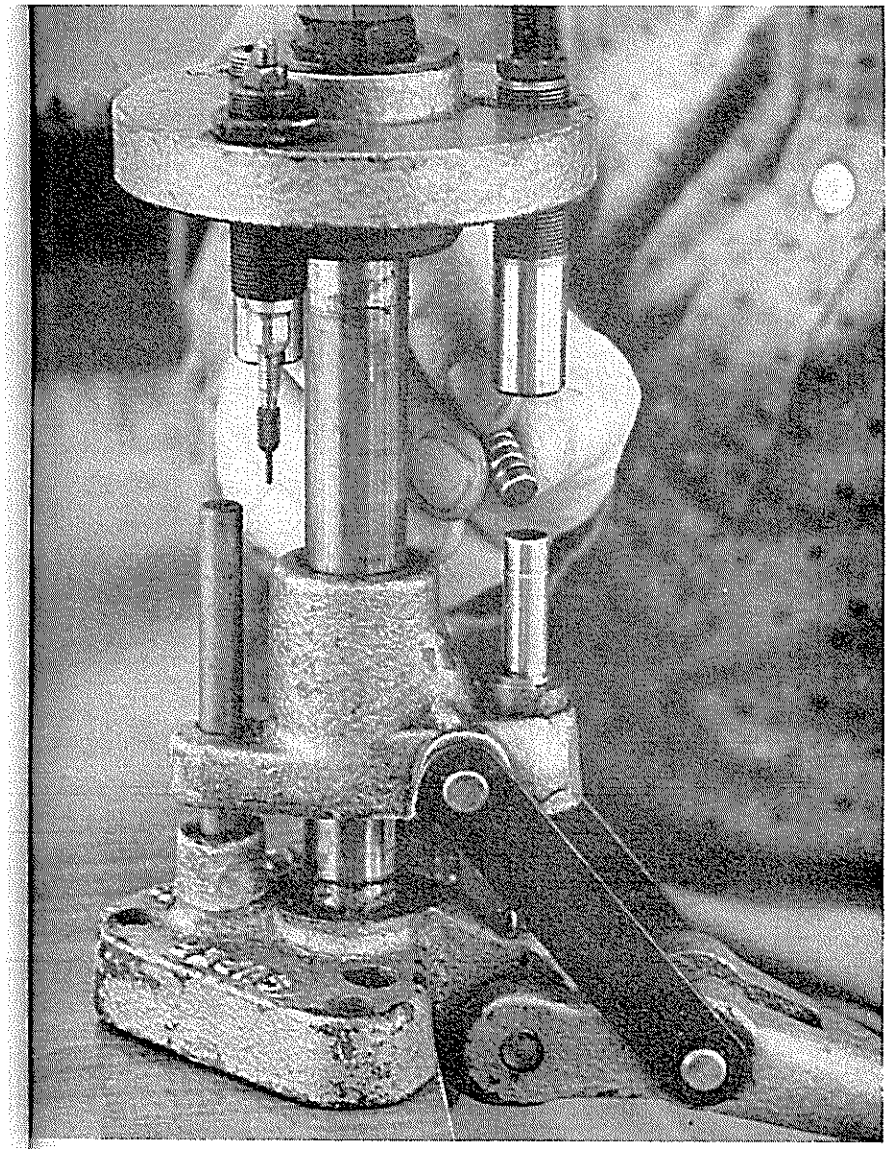
When the case is ready for recharging, place it base uppermost in the loading block. Powder bought in bulk should be stored in airtight dark jars. Since many powders look very much like one another, differing only fractionally in grain size and color, it is impossible to nominate a powder on sight. Accordingly, the jar containing the powder should have a distinctive label pasted on the outside. Colored cardboard should be used cut to a certain shape and labelled with the powder name. Inside the jar a number of identical labels should be placed containing the loading information for a particular rifle. This guards against the outside label dropping off.

The powder measure is then adjusted to throw the required load. Anything up to a dozen loads are discarded until the powder settles down into flow lines inside the measure. The measure will now throw regular loads correct to half a grain. The powder loads should be adjusted to the rifle so that maximum accuracy is obtained. Maximum loadings should under all circumstances be weighed after being measured. Maximum loads are unduly hard on the case and markedly shorten barrel life. Even when the measure is running correctly, every tenth load should automatically be checked.

Loading for extreme accuracy, the charge is thrown and then weighed, the measure being set a fraction under the required loading. There are several auxiliaries available on the market loosely called powder drippers. These deliver very small quantities of powder to permit the exact powder charge being weighed. Experience indicates that a plastic scoop — which prevents problems with static electricity — is equally satisfactory.

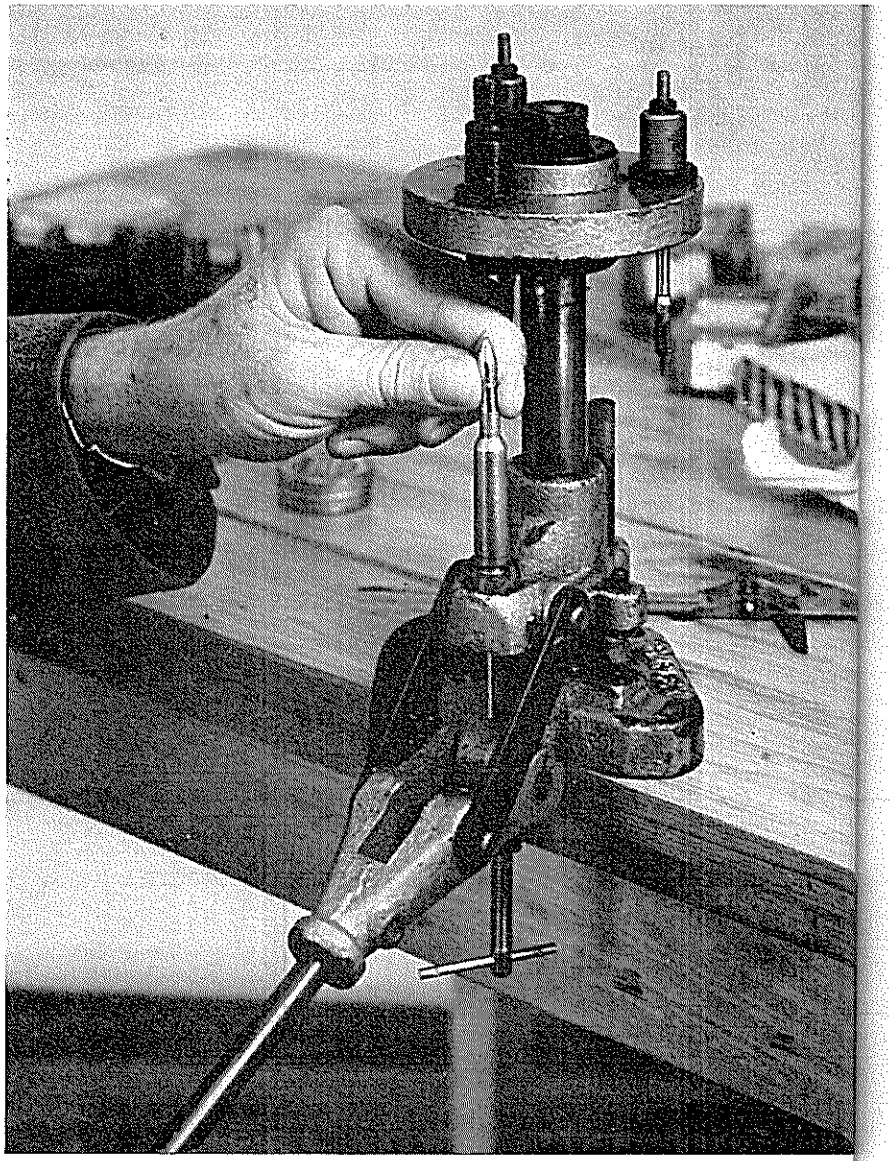


The charge of powder is run into the case using a powder funnel. The one used is a GUNS product and handles all cases from the .22 up to .45 calibre or so. Where the powder measure is used, then the charge is run straight into the primed case and it is then put back into the loading block ready for the bullet seating. Using powders like 4831, the very large granules of powder do not run freely, and an added complication arises in using heavy charges that fill the case and need shaking down. It is preferable to run the powder into the scale pan and then add slowly to the case through the funnel. The base of the case is bumped on the bench to settle the powder as it is added from the pan. It is desirable to gently tap the drop tube of the measure if you have any doubts as to whether the full charge has been collected.



A gas-check bullet, already lubricated and sized to 0.357 inch, is being put into the case mouth. Dry lead bullets are never used, and the gas-check is used to prevent leading in the pistol barrel. In the rifle it permits velocities up to 2400 fs instead of about 1600 fs but its real asset is to permit a softer alloy of 1 in 15 tin to lead to be used at higher velocities, enough to flatten the rainbow trajectory of which this soft, readily expanding alloy would have to be driven at if not stiffened up and the base protected by the deep base gas-check.

Seating depth is adjustable and in a hunting rifle, the bullet should jump about one 16th of an inch before hitting the lands in the throat. Seating right up with heavy loadings is dangerous because the bullet cannot readily move as the pressure goes up. For the pistol, seating depth is controlled by where you sink the bullet into the crimping groove, and there is no latitude as all bullets are crimped with heavy loads.



The final step is to seat the bullet to the right depth. An empty fired case is lightly neck-sized so that it will just hold the bullet. It is fed slowly into the chamber so that the bullet is free to move back on meeting the rifling lands. Then it is removed carefully from the chamber and the overall length measured. The calipers are then set one sixteenth of an inch shorter than this length. This is true of all high-power centrefires. The tool is adjusted to this measurement and the bullet seated on the primed loaded case. With reduced loads, the bullet may be seated so that it touches the rifling. This often gives better accuracy than the bullet which makes a slight jump to meet the rifling. With gas-check bullets, difficulty may be encountered if the rifle is unloaded as the bullet may pull out of the neck spilling the powder charge into the action. This applies only to box magazine rifles.

CHAPTER SEVEN

Headspacing and Trimming

HEADSPACE measurement applies to both rifle and cartridge, and it must be maintained correct in both or there will be trouble. Headspace in a rifle is the distance between the face of the bolt or breech block and the stop in the chamber that prevents the cartridge from going too far into the chamber. Headspace in a cartridge is exactly the same — the distance from the head of the case to that part of the case that strikes the stop in the chamber. In both cases the measurement is one of length, not diameter.

If the headspace in the rifle is too short, or the headspace in the cartridge is too long, you cannot get the cartridge into the rifle and close the breech without using prohibitive force, and that's all there is to that.

But if the headspace in the rifle is too long, or the headspace in the cartridge too short, then a number of very undesirable things may occur.

Firstly, the cartridge may seat so deeply in the chamber that the firing pin will not strike the primer, or will not indent it sufficiently, and a misfire or a hangfire may occur. Secondly, if the cartridge does fire, the cartridge case expands and stretches lengthwise abnormally. It sometimes stretches so much that the brass case ruptures, allowing the hot powder gas to come back outside the case, against and through the bolt.

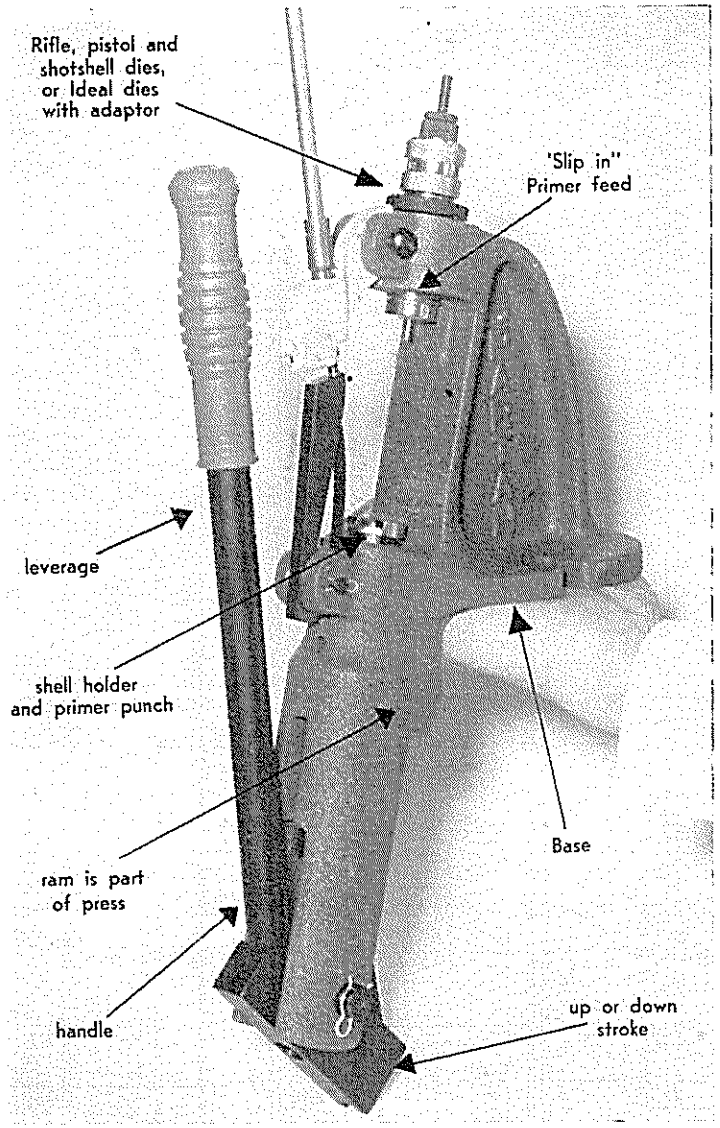
If this happens a primer may blow, a flash of gas may come back through the bolt and into your eyes, the case may separate (split in two just in front of the head) and the front portion may stick tightly in the front part of the chamber and be difficult to remove. Or the escaping gas may enter and distort or destroy the magazine or carrier and splinter the stock, or the rare and worst thing that may happen is that the whole breech mechanism may shatter and destroy the rifle.

Therefore, in handloading, you must take pains to see that the cartridge headspace is always correct. There is scarcely any chance of making it incorrect except when we use a full-length resizing die in a reloading tool, which is why we have to bring the matter of headspace up at this stage of handloading.

With rimmed and belted cases, headspace is the distance in the rifle from the face of the bolt to the shoulder in the chamber against which the rim or front of the belt on the case rests. In a cartridge it is the thickness of the rim or the thickness of the belt. This dimension depends on the tolerance allowed in the manufacture of the cartridge case. Generally speaking, the minimum headspace in a rifle is the maximum allowable rim or belt thickness in the cartridge, and the maximum allowable headspace in the rifle is about .004 in. greater than this.

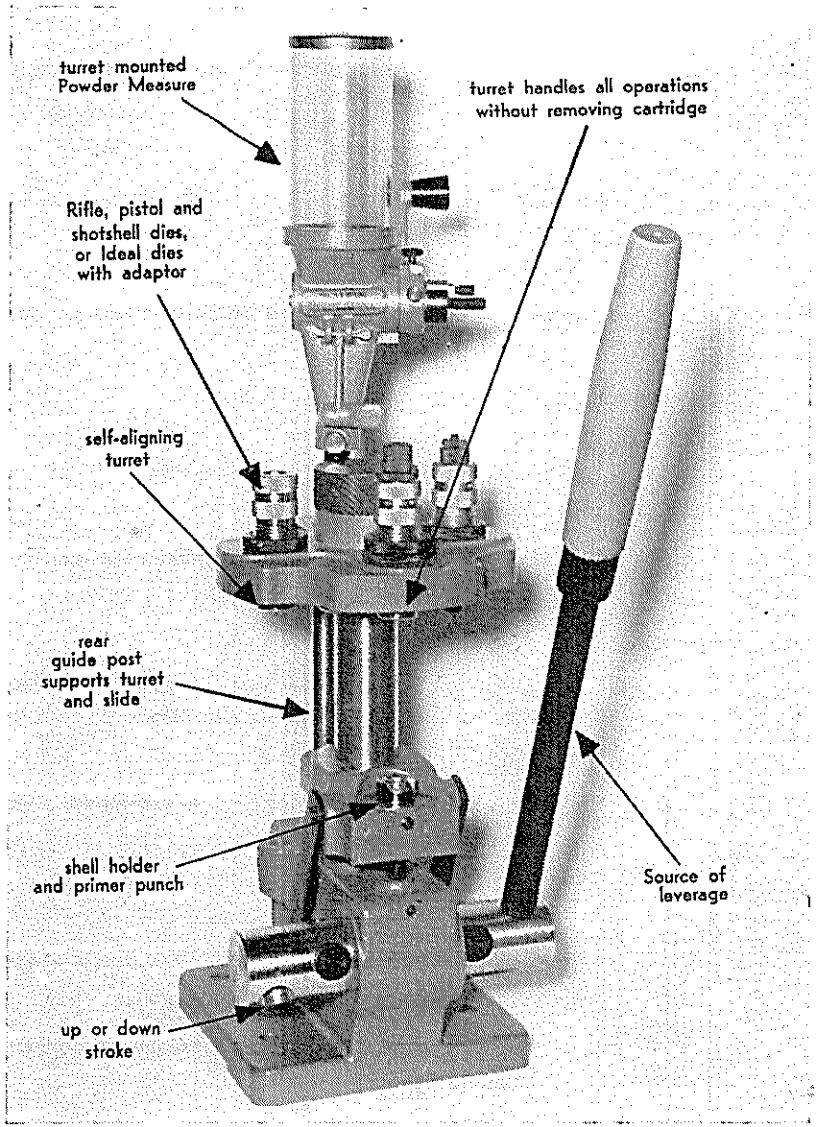
We seldom run into any cartridge headspace difficulties with rimmed or belted cases. If there is trouble it is usually due to the rifle which should be returned to its maker for correction. All you have to do is to screw the full-length resizing die into the reloading tool, resize a case with it, and compare that case with a standard factory-loaded cartridge, adjusting the tool until the shoulder of the resized case appears in exactly the same position as the shoulder of the factory cartridge.

When the two appear the same, try the resized case in your rifle. If it



Lyman Comet reloading press.

requires quite a tug on the lever or bolt or handle to close the breech then the die should be screwed just a little tighter into the tool, until it requires just a perceptible tug or pressure to seat the case and close the breech, but not enough so it would bother you in rapid firing. Then screw up the stop collar on the die and go ahead and full-length resize your lot of cases.



Lyman All-American reloading press.

As a matter of fact, in resizing a rimmed or belted case, even if the die sets the shoulder (in rear of the neck) back quite a little, it would not necessarily make the cartridge unsafe. The case would still be held to correct headspace by its rim or belt, and the gas pressure, if not abnormally heavy, would just swell the neck and forward part of the body out to fit the chamber.

This is exactly what is done in fire-forming many rimmed or belted wildcat cartridges. See under ".219 Donaldson Wasp."

There is a limit, however, to the amount of this pressure expansion that can be done. If the brass is expanded too much, or if the brass is poor and brittle, the case may crack or split. Even then the consequences are not likely to be serious with a rimmed or belted case.

With rifles using rimless cases, headspace in the rifle is the distance, determined only by a standard headspace gage, from the head of the bolt to a point on the shoulder of the chamber. With the cartridge it is a similar distance from the head of the case to the shoulder. Standard headspace gauges are made for a few of our rifles and cartridges by certain manufacturers. If gauges are available, place the minimum gauge in the reloading tool and then screw in the full length resizing die until it makes firm contact with the gauge, when the handle of the tool is closed, and then screw down the collar and clamp the die.

If no headspace gauge is available, then proceed to adjust the die with respect to the shoulder of the case as described in the preceding paragraph for rimmed or belted cases, but adjust the die so it takes a little more of a tug or press on the lever or bolt of the rifle to close the breech on a resized case.

Allowable headspace with rimless cases. It cannot be stated how much headspace over the minimum is allowable because this depends on the breech pressure and the quality of the brass. The bolts on the .30-06 Springfield Army rifles are individually fitted so that the bolt will just close on the minimum headspace gauge, which is known as the "1.940" gauge. The rifle is proof fired by firing two proof charges in it, and after that the rifle must not accept the "1.943" gauge; that is, the headspace must not be over .003 in. longer than minimum. Rifles that have been cleaned and repaired at arsenals and then issued must not accept the 1.946 gauge (.006 in above min). At the annual inspection of rifles, when a rifle is found that will accept the 1.950 gauge it is withdrawn from service and sent to an arsenal for repair or destruction.

But we are not prepared to state that .010 in. headspace above the minimum is safe with any rifle or cartridge. It depends upon many things. With a combination of poor brass in the case, a fold, or dirt laminated into a case, a relatively high breech pressure, an oily chamber, and a day hotter than normal, the stage might all be set for a serious accident with a headspace .010 in. above minimum.

With auto pistol cases, headspace in the pistol is the distance from the face of the bolt to the shoulder at the front end of the chamber, and with the cartridge it is the distance from the head of the case to the square mouth at the front end of the case. The square mouth of the case abuts against the shoulder at the front of the chamber and holds the case back against the bolt face, supporting the head of the case and the primer against the blow of the firing pin.

Auto pistol cases are simply resized for outside diameter, and the interior of the case is expanded for bullet fit, usually by simple neck resizing. They are not chamfered or resized for length, although after repeated loadings and firings, they may lengthen slightly and have to be trimmed for length. Simply compare the neck resized case with a factory cartridge to see that its length from head to mouth is practically identical.

When in doubt about rimless or semi-rimless cases, it pays to try them in the chamber. If the bolt closes with just a fraction of resistance at the end of its travel all is well. Remove the case and you will find a bright mark on the shoulder. This is as it should be. If the case goes easily into the chamber and any doubts are felt, there are two simple procedures to ensure that separated cases do not occur. Load the cartridges through the magazine slowly and deliberately so that they lie against the bolt face when seated in the chamber, and load the bullets out so that they just contact the lands when fully seated home in the chamber.

In this instance it pays not to neck size the case any more than is necessary to just hold the bullets securely. Do not use maximum loads under such circumstances, and if the cases are being altered by an improved chamber then do not expect the case to form properly with reduced loadings. They will form to some degree, but not being in full contact with the chamber the heat of the burning powder will make the grass very brittle and on a second firing with a heavy charge the case will split badly.

Always use brass, new or resized with a medium or near heavy powder charge. Oiling of cases should be avoided like the plague.

As cases are continually resized, reloaded and fired they tend to lengthen a little, and get longer than normal from head to mouth. In the normal centrefire rifle, and in the cylinder of most revolvers, there is a shoulder at the extreme front end of the chamber where the chamber itself ends and the lead and bore proper start. The total length of the chamber from the face of the bolt to this shoulder is usually about .05 in. to .10 in. longer than the overall length of the normal case, so that the case can expand or lengthen slightly when fired without coming into contact with this shoulder in the chamber.

But after repeated use its overall length may increase until finally it may abut hard against this shoulder, or the shoulder may sort of crimp the case on to the bullet, and the case and bullet may thus cause serious constriction at the mouth of the chamber. This might result in a considerable increase in breech pressure, perhaps a dangerous increase, and accuracy would also probably suffer.

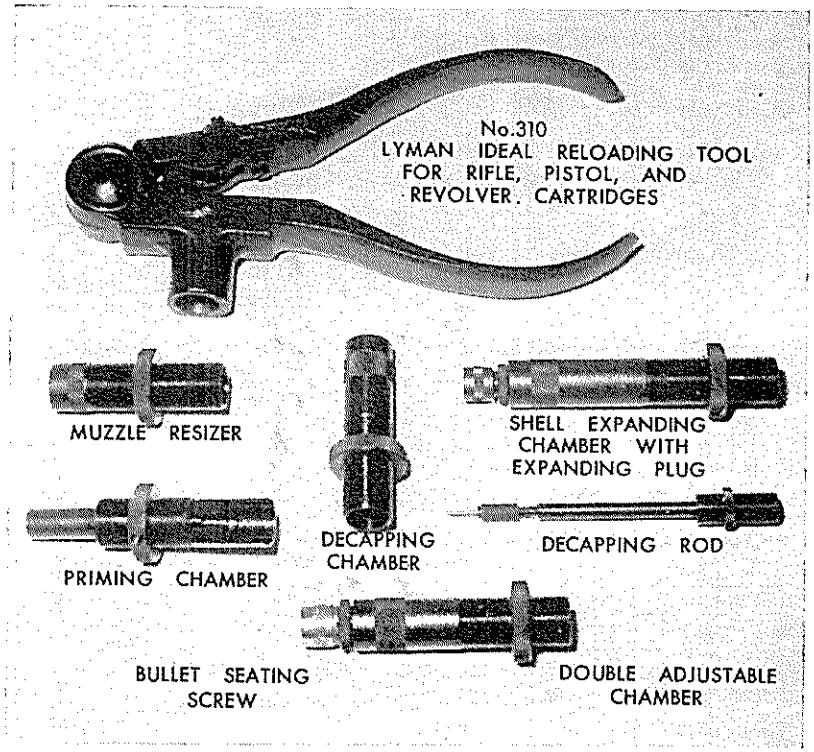
The avoidance of this condition is simple. When you have completed resizing a batch of cases compare a few of them for overall length — head to mouth — with a new standard factory cartridge. If they appear to have lengthened noticeably they must be trimmed for length; that is ground, reamed or filed off to standard length before loading again. A number of tools for this operation are available, some work in the regular reloading tool, some work in a completely separate operation.

Our experience has been that when using the better grade of bolt action rifles which have quite accurately cut chambers, this lengthening of cases seldom occurs to any appreciable extent and when it has with me it is usually because the cases have been fired 20 or 30 times, and we simply throw them away. But the rifle chamber, particularly with lever action rifles, may cause cases to lengthen much faster, and this condition must always be watched for.

The .220 Swift. Here is a case where unusual precaution has to be taken. The breech pressure and the angle of the shoulder are such that the brass of the case seems to flow or be extruded forward into the neck. The case lengthens and the wall thickness of the neck increases, so that often after the case has been reloaded about three times the increased length and thickness take up all the available space in the neck and front end of the chamber, and a serious and dangerous constriction is liable to occur.

So with .220 Swift cases that have been fired with full charges make it a rule, after they have been reloaded three times, to ream the neck of the case to standard wall thickness, and to trim to standard length before reloading again. This is done with a neck reamer and trimmer. It should be done again after about three more firings, but it is best to limit these cases to six firings, with reaming and trimming after three. The .220 Swift is known as a "semi-rimless" case, but it is headspaced by its shoulder like a rimless case.

While this comment is undoubtedly true of most rifle cases of the older styling, due regard must be paid to new cartridges which are continually being reduced in size to operate with greater efficiency with the new powders. Shoulders are sharper and body taper less but pressures are higher and pressure peaks have a longer duration. This is not an invitation to buy a neck trimmer and use it every time you reload, but a suggestion that you get a snap length gauge or an ordinary vernier caliper, set it on a specimen case keep for that express purpose and check your brass, before running it



The Lyman Model 310 reloading tool and components.

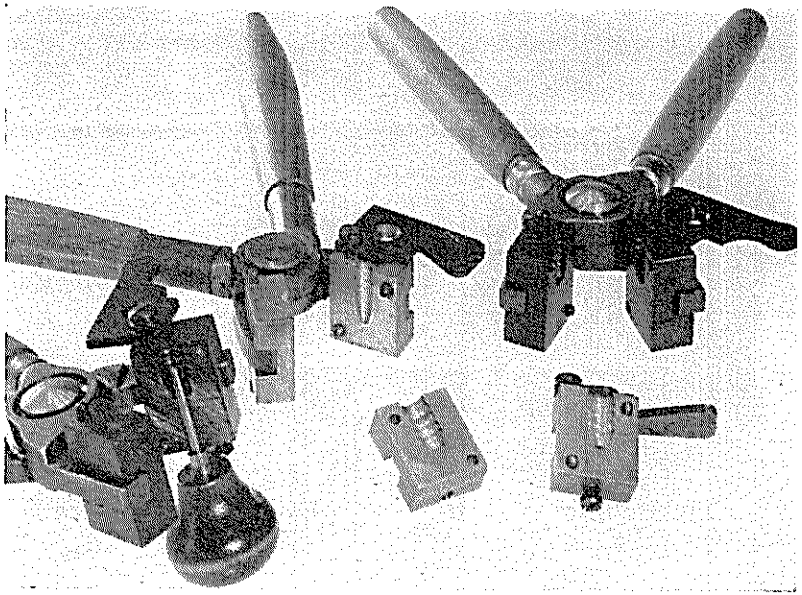
through the chamber to ascertain whether or not it does need trimming for length. This is a precautionary measure only as sometimes the factory cases may be overlong for the chamber.

Check fired brass for any new rifles with the base of bullet of appropriate size as this should enter the case mouth freely. If it should not shorten the case slightly, chamfer the inside, reload the case and try again. This is particularly the case with wildcat brass, but difficulties arising from thick necks should not be mixed up with those from over-long brass, although the results in both events affect accuracy and raise pressure levels.

Forming wildcat cartridges: The method of forming cartridges for various wildcat rifles differs with each wildcat rifle, and generally speaking, you should take the advice of the gunsmith who makes the rifle. It is perhaps easiest of all with the .219 Improved Zipper cartridge. Simply fire standard .219 Zipper factory loaded cartridges of Winchester or Western make in your Improved Zipper rifle, then they are all ready for reloading when you have run them through your Improved Zipper resizing die to resize and expand the necks to hold your bullets friction tight.

Forming cases for the .22-250 Varminter rifle is also easy and simple. Simply run new .250-3000 Savage cases into your Varminter resizing die, thus sizing down and expanding the case neck to hold your bullets properly.

Forming .35 Whelen cases is also easy. Simply take new .30-06 cases and run them them into the R.C.B.S. .35 Whelen expanding die that expands



This picture illustrates three different styles of moulds on the Australian market. Left, the Lyman hollow-point. Centre, the Harrison, with blocks of phosphor-bronze. Third is the standard type of mould by Lyman. Only one pair of handles need be purchased for use with any number of blocks.

their necks to about .35 calibre. Then run them into the .35 Whelen expanding and resizing die which sizes the inside of the neck to hold the bullet. There is no change in the shoulder of the case at all.

Some of the heavier wildcat cartridges of larger power capacity use cases with the same belted head as the .300 H&H Magnum and .375 Magnum cartridges. The Norma Company can furnish empty cases without primers (they use American .210 primers) that are cylindrical in form, and not necked down at all. Neck these cartridges down in appropriate dies. If you are necking these cases down as small as .30 calibre or smaller you will probably have to use two expanders in your die, one to neck them halfway down, the other to complete the necking to the desired calibre. A little case lubricant should be used on these expanders to keep them from sticking inside the cases. If your wildcat case is much shorter than these Norma cases it may be necessary to trim them to almost but not quite, the desired length, before necking them down, then afterward, when completed, trim them to the exact length. If you neck these Norma cases down to small calibre you will naturally crowd a lot of brass into the walls of the neck, and the wall thickness of the case may be too tight for your chamber when you seat a bullet in it.

Buy a reamer which will ream out the inside of the necks of cases that are too thick in wall thickness, to the desired thickness. After these cases have been thus necked down they should be run into the expanding die for the particular wildcat cartridge to make the neck the desired size, then trimmed to exact length, and the mouth of the case should be chamfered. Then fire them in your rifle to expand them to exact chamber shape and form the shoulder properly, using a powder charge several grains lighter than the normal charge, and with a normal bullet. They are then ready to

be loaded with the charges which the maker of your wildcat rifle advises.

Fire-forming a case for use in a wildcat rifle cannot be done properly with a light powder charge. You should use a powder charge, say, only about two to five grains less than the normal charge for the cartridge. If this case to be fire-formed is rimless, then you must load the bullet far enough out of the case to surely contact the lands when you load it into your rifle, so as to surely hold the head of the case into firm contact with the bolt face. Otherwise, when it is formed the case head may have been forced a little forward, and that case will be formed with insufficient headspace.

Best results are almost always obtained with cases that have been completely formed as above, and then have been fired at least once in the rifle to expand them to correct chamber fit, after which they should be trimmed for length if necessary, resized and expanded in the neck resizing die, and the mouth of the case chamfered. They are then ready for loading for maximum accuracy.

The .219 Donaldson Wasp cartridge is perhaps the most tedious to form. It is formed from the .219 Zipper empty case, preferably of Winchester or Western make. First of all, the case is lubricated and then run into a Wasp resizing die which forms the shoulder backward to approximately right location, and these dies are usually made so that when the case is driven into them up to the head, a portion of the neck of the case projects out of the top of the die.

This projecting top is then cut off with a fine hacksaw, and at this point some reloaders run a reamer into the neck of the case while it is still in the die to ream the neck to the desired wall thickness. Then the case is removed from the die, loaded for fire-forming, and then fire-formed in the rifle to expand its body below the shoulder to the desired increased diameter, and to form the shoulder exactly. From then on it is treated just exactly like a normal fired case. #

CHAPTER EIGHT

Priming

THE fired case has now been wiped clean, chamfered, resized, neck expanded, decapped, inspected, and is now ready to be actually reloaded with primer, powder and bullet. The first process in the actual reloading is priming — inserting a new primer in the primer pocket of the case.

Choosing the proper primer. As will be seen from the accompanying table, there are three sizes of single flash-hole or Boxer primers, measuring in diameter .175 in., .204 in and .210 in. As the .204 in. size is suitable only for the .45 Colt Auto Pistol cartridge made by Frankford Arsenal, you would be almost correct in saying that there are only two sizes of primers. The .175 in. primers are called "small primers," and the .210 in. "large primers".

In each size different strengths of primers are made. Pistol primers give a smaller flash, and have thinner metal cups, easily indented by the weaker mainsprings of pistols and revolvers. Except in certain special cases they are suitable only for pistol and revolver cartridges. They might be punctured by the heavier blows of rifle firing pins, and they might not ignite rifle powders properly. *Rifle* primers emit a larger flash, and have thicker metal cups, and they in turn are suitable only for rifles, might not be properly indented and fired in a pistol, and their strong and hot flash might over-ignite pistol powders.

BOXER PRIMERS

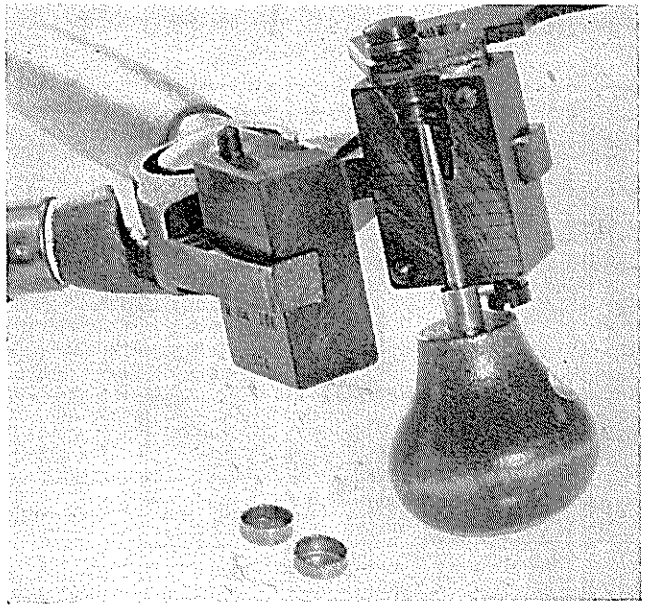
	Large Rifle		Small Rifle		Large Pistol		Small Pistol	
Make	No.	Diam.	No.	Diam.	No.	Diam.	No.	Diam.
Federal	210	.210	200	.175	150	.210	100	.175
Frankford	.30	.210			.45	.204		
Peters	12	.210	65	.175	20X	.210	15	.175
Remington	9½	.210	6½	.175	2½	.210	1½	.175
Cascade	200	.210	400	.175	300	.210	500	.175
Western	8½	.210	6½	.175	7	.210	1½	.175
Winchester	120	.210	116	.175	111	.210	108	.175
RWS	2845	.210	2841	.175	5304	.210	1961	.175
ICI				.175				
Norma		.210		.175		.210		.175

BERDAN PRIMERS

ICI		.251		.175		
RWS	6000	.250	1584	.177		.176

To meet the needs of some special cartridges, slight variations on the above tables are in order. While the .38-40 Winchester is normally found with the large flash hole for the .210 primer, the .44-40 may be found with either. The .357 Magnum taking the small primer is loaded by Remington with the rifle primer, and Cascade put out a special Magnum primer for the same purpose.

For some high intensity cartridges, the new flock of 'Magnums' being in this class, Norma and Cascade make a special primer with a hotter flame than usual to ignite the special powders commonly used in these large capacity



Close-up of a Lyman hollow-point mould, of the gas check type. These bullets are suitable for high velocities up to 2200 fs in rifles.

belted cases, the .358 Norma rifle cartridge being the upper borderline as above this calibre standard primers are adequate, even desirable.

Primers can be bought from dealers in reloading components (see the Appendix). They come packed in boxes of 100, and in cartons of ten boxes (1,000 primers). Not less than 100 can be sold to a purchaser, and it may be cheaper to buy them by the thousand. They cannot be mailed, but must be shipped by express. Store them in a cool, dry place.

One of the best methods is to place the packets of primers in an air-tight screw top jar. In the tropics, it is preferable to transport and store primers in tins, with plastic tape around the joint of the tin. Changes in humidity or excessive humidity in the air plays hob with primers. This is one time it pays to reload cases immediately and to make doubly certain give the primer a coat of lacquer like nail varnish to form a colored seal identifying the loading around the edge of the primer pocket.

You can always tell the size primer a case takes, whether .210 in. or .175 in. by measuring the diameter of the primer pocket, or indeed by just looking at it. It is desirable, although not absolutely essential, that you use the same makes of case and primer. That is if you are using Remington cases use Remington primers, and thus you may avoid a slight misfit of primer in primer pocket, although such misfits seldom occur.

To prime the cases. Arrange the reloading tool for repriming according to the instructions that accompany it. Insert the empty case in the tool, and insert the new primer in the seat provided for it, or in the priming stem or arm, or balance it on top of the primer pocket of the case, according to the way the tool works.

Close the tool and press the primer into the primer pocket. It should go in easily without using any force at all. Just a little practice will give you the skill to insert it smoothly and easily. Be sure you continue the gentle pressure on the lever of the tool until you feel the primer seat right down to the bottom of the pocket. Then reverse the lever and take the primed case out of the tool.

Occasionally, as you start to press a primer into its pocket, you will feel

the primer hang-up on the edge of the pocket. Don't try to force it in. Reverse the lever, turn the case around in the tool about half a turn and then almost always the primer will seat easily and smoothly. If you have extreme difficulty in seating a case and primer check carefully if you are using military brass as this is usually an indicator that the crimp has not been correctly removed from the edge of the primer pocket.

Primers that go in too easily are usually an indication that primer pockets have been expanded through over-loading for that make of brass, and the case should be belted with a hammer on the spot to remove temptation and avoid mix-ups at a later stage.

It is very convenient to have a small pan with an edge to it, like the top of a pressed-top tobacco pan. Turn down a portion of the edge about an inch wide so it forms a lip of the same height as the surface of the pan. Secure this pan on a block of wood so it will lie firmly on the loading bench. Pour out your primers onto this pan. Shuffle the pan, and 90 per cent of the primers will turn cup-side up. Turn the remainder cup-side up with the fingers. Then, when wishing to insert a primer in the priming arm of the tool, place the forefinger of your left hand on top of a primer, drag it along the top of the pan to the lip, where it slides into and is grasped by forefinger and thumb. Then it is easily inserted in the cup of the priming arm with the same left hand.

Right away one gets to feel with his fingers that the primer is inserted correct side up in the priming arm. This gadget makes inserting of the primers in the primer cups very easy and saves a lot of time.

Sometimes you may wish to remove live primers from primed cases to insert another type of primer. This is always attended by a certain small risk, but with commercial cases (where the primer is not crimped in) it can be done by exercising care. Press the primer out slowly so as to avoid any suspicion of a blow that might ignite the priming mixture. Keep the face

away from the tool in the unlikely event that the primer might ignite and cause an alarming flash-up. Destroy the ejected live primers as they will not be sure to fire.

But under no circumstances should any attempt be made to force live primers out of government cases in which they are crimped as there is great danger that the effort will cause the primer to flash. Snap these primers in an old rifle, and then drive them out.

Inspection. As you remove the case from the tool draw your finger over the head. After a few trials you will be able to tell by feel whether the primer is seated fully down in its pocket, with the cup of the primer just barely below the surface of the head of the case, or whether it projects too far, or has been seated crookedly.

When you start to handle primers stop smoking. Never under any circumstances attempt to prime a case that contains powder. Never strike the primer a blow with the reloading tool punch to try to force it into its pocket. Use gentle firm pressure only. If primers drop on the floor pick them up at once — they might get stepped on, explode, and cause an injury or fire. WIPE ALL OIL AND GREASE FROM THE HANDS, cases, and tools when handling primers, for grease or oil on primers kills them.

Automatic primer feeds. Some reloading tools have automatic primer feeds, either a part of the tool or procurable as an extra. A long tube is filled with primers, all faced in the same direction, and this tube carries each primer in turn into position to be pressed into the primer pocket simply by the movement of the tool lever. Thus each primer does not have to be handled individually with the fingers. Sometimes a funnel shaped pan is provided to funnel the primers into the tube, but it is still necessary to turn the primers right side up on the pan so they will all go into the tube faced in the right direction.

It is questionable whether an automatic primer feed actually expedites the operation of priming unless one is loading in very large quantities. Often the difficulty and time taken in filling the tube with say 50 primers all faced correctly, is as much as that taken in handling each primer separately with the fingers.

After repriming set each case, mouth down, primer end up, in the loading block. This is simply a board drilled with a number of holes in which cases can be inserted. Its principal purpose is to prevent cases upsetting on the loading bench when filled with powder, and before the bullets are inserted, and as the block is usually made to hold either 20 or 50 cases it also serves as a counter. Loading blocks can be obtained from all dealers in loading tools.

After all the cases are primed and placed in loading blocks, run your eye along the rows of cases to see that each and every one has the primer completely seated, head of the primer just barely below the head of the case, and that none is seated crooked. The cases are now ready for charging with powder. #

UNPRIMED CASES

When a rifle has been bought, it may be found desirable to purchase unprimed brass and work out loads immediately to suit the rifle rather than just purchase factory ammunition.

As has been mentioned throughout the book, this will give a marked saving as regard costs and at the same time fit the rifle for the type of shooting to be found in your favorite hunting grounds.

Hereunder is listed the brass which may be purchased locally:

Cartridge	Norma	Metallverken
.222 Remington	Yes	Yes
.220 Swift	Yes	No
.243 Win	Yes	Yes
.244 Rem	Yes	Yes
.250 Savage	Yes	No

.257 Roberts	Yes	No
6.5 Jap	Yes	No
6.5 x 54 MS	Yes	No
6.5 x 55	Yes	Yes
.270 Win	Yes	Yes
7 x 57	Yes	Yes
7 x 61 S&H	Yes	No
.30 M1 Carbine	Yes	No
.30-30 Win	Yes	Yes
.308 Win	Yes	Yes
30-06 Springfield	Yes	Yes
7 x 62 Russian	Yes	No
.308 Norma Mag	Yes	No
.300 H&H	Yes	No
.303 British	Yes	Yes
7.65 Argentine	Yes	No
7.7 Jap	Yes	No
8 x 57 J	Yes	No
8 x 57 JR	Yes	No
8 x 57 JRS	Yes	No
8 x 57 JS	Yes	Yes
8 x 60 S	Yes	No
.358 Win	Yes	No
.358 Norma Mag	Yes	No
9.3 x 57	Yes	Yes
9.3 x 62	Yes	Yes
9.3 x 74 R	Yes	No
.375 H&H	Yes	No
9 mm Luger	Yes	Yes

CHAPTER NINE

Smokeless Rifle and Pistol Powders

ASSUMING that black powder will not be used, we can divide smokeless small arms powders into three general types: (1) Shotgun Powders. (2) Rifle Powders. (3) Pistol and Revolver Powders. Shotgun powders should never be used for loading rifle or pistol cartridges as they are often exceedingly dangerous when so used.

There are many different kinds of both rifle and pistol powders, each being best for a particular type of cartridge or use, but unsuited and perhaps dangerous for another use or in some other cartridge. Be sure you use the right powder. You cannot well go wrong if you follow the instructions later to be given as to loading each of the different cartridges.

In Australia, smokeless powders must be sent by rail—they cannot be posted. The powder must be packed in tins inserted in wooden boxes. The powder must be declared. It usually comes in one pound or half-pound tin canisters with screw-on top.

Smokeless powder may be safely stored in any dry place that does not become excessively hot. Not, for example, in an attic that might become very hot in summer, nor close to a stove, furnace, or heat register. When the top of a canister of powder is unscrewed to fill a powder measure, or to return unused powder to the canister, always screw the top of the canister back on again immediately. Examine the label on the canister every time to be absolutely sure you are using the right powder, or returning the powder to the right canister.

Burning of powder. Smokeless powder ignited in the open does not explode, but rather burns or blazes up with a hot flame which may endure for several seconds.

For example, you can empty the small amount of powder contained in a rifle or pistol cartridge into a pile on a piece of paper and touch a match to it. The pile will flare up with a bright flame and a small "hiss" for perhaps two seconds, and while it will not ignite the paper on which it rests, it will scorch it. But do not try this with black powder which would explode. Black powder is far more dangerous to handle and store than smokeless powder.

When the powder within a cartridge is ignited by the hot flash of the primer it starts to burn, and as it burns it develops a very rapidly expanding gas which builds up pressure within the case, chamber and bore of the weapon. This gas, seeking a means of escape, pushes the bullet, the only movable item, out of its case and up and out of the barrel.

The larger the amount (charge) of powder placed in the cartridge the more gas will it generate, and of course the more gas, the greater the pressure. Also the more tightly the gas is stoppered by the bullet the greater the pressure.

A heavier bullet, or one that fits tighter in the bore will cause a higher pressure. If the case and chamber were stoppered completely so that no gas could escape, the powder would explode rather than burn, or perhaps detonate, and would blow up the weapon unless it was remarkably strong.

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NEVER smoke nor have any matches around when handling powders. Never handle powder in a room where there is a naked light — candle, lamp or stove.

Smokeless powders are formed in small grains which may look like perforated cylinders, washers with or without a central hole, flakes, small balls, or small irregular lumps. Generally speaking the finer or smaller the grains the faster will the powder burn, and the more gas will it generate for a given weight or charge.

Pistol powders are designed to burn more rapidly than rifle powders because they have to generate the necessary gas and pressure to drive the bullet at the required velocity up a very short barrel in which they do not have much time to burn.

Besides being of different granulation, various smokeless powders are made of different ingredients and proportions of those ingredients. Some of these burn faster than others. In this way the powder companies make up a large number of different powders, each designed to burn and generate its gas in a certain manner best suited to a certain cartridge and weapon. Let us take a few general examples.

Use the correct powder. A pistol powder may be designed so that a proper charge will burn and generate just enough gas to drive the bullet through the short 6 in. barrel of a pistol and have the bullet come out the muzzle at a velocity of, say, 1,000 feet per second. This powder in various charges may also be used in other pistol cartridges to give muzzle velocities of from 800 to 1200 feet per second. But if we used this powder in larger charges in an effort to get, say, 1,600 f.s. in a certain pistol, the large charge and the resulting high pressure might burst the pistol which was not designed to stand anything like the high pressure that this charge will give.

Again, this same fast-burning pistol powder used in a light charge in a rifle would all burn close to the breech of the barrel, and the bullet would leave the muzzle with a very low velocity, or it might even stick in the barrel. On the other hand if we used more of this fast burning pistol powder in the rifle in an effort to get higher velocity, the powder burning very fast would set up a high and unsatisfactory chamber pressure without enough continuing push through the entire bore to give the muzzle velocity we wished.

If we used still more powder the pressure would rise very fast to a dangerous extent, probably blowing out the primer, rupturing the brass case, or even demolishing the breech action of the rifle. So we can see that this pistol powder is utterly unsuited for, and indeed often dangerous when used in rifles.

Other powders are designed for use in the older cartridges formerly loaded with black powder and lead bullets, to give moderate velocities under about 1,600 f.s. and for use in reduced loads and mid-range loads in certain more modern rifle cartridges with either lead alloy or metal cased bullets. These powders are designed to burn at a low pressure and at a cool temperature. If we load larger charges of them in a rifle cartridge in an effort to get higher velocity, we get an extremely high and perhaps a dangerous pressure.

The gas from this excessive charge may be so hot that it burns or erodes out the breech of our rifle barrel in a few hundred rounds, or if we were using a lead alloy bullet it might start the lead bullet melting while it was in the bore and we would get no accuracy. On the other hand, in a few specific cases it is possible to use these low pressure rifle powders with fair success in certain revolver cartridges.

Certain other powders are designed to give high velocities in rifle cartridges with metal cased bullets. Some of them are designed to burn well at pressures of from 30,000 to 45,000 pounds per square inch and produce standard velocities in certain rifles, often in lever action rifles. Others are designed to burn best at 40,000 to 55,000 pounds pressure in certain other cartridges to give standard higher velocities, perhaps in the stronger bolt action rifles.

These powders are strictly high velocity powders, and cannot be used in much smaller charges to give reduced velocities for short range loads because they would not burn correctly at these low pressures, and indeed the primer might not properly ignite the powder. Some of these powders are made

for the smaller rifle cartridges with light bullets, and others are made for use in much larger cartridges with heavier bullets.

So you can see the high desirability, in fact, the absolute necessity of using the right powder for a certain cartridge and bullet. And likewise the very unsatisfactory results and often the very great danger that comes from using the wrong powder, or even the wrong amount of the right powder. There is, however, no danger in any of this if you will follow the instructions in this book.

RIFLE POWDERS

The following are the rifle powders now available for handloading together with the general class of cartridges and loads for which they are suitable.

Although many of the best American powders are not freely available on the Australian and New Zealand markets, the description of their characteristics and burning rate were included to permit comparison with powders that are available here and to make possible use of the American Handloading articles.

One that is of value is the Norma Manual No 62 called 'The Norma Gunbug's Guide'. This lists American powders and their Norma equivalents, and points out that although powders by different companies may be used in similar loadings in the same cartridges their burning characteristics should never be assumed to be the same as those they replace.

DuPont IMR No 4227. For small-capacity cartridges with metal cased bullets, like the .22 Hornet, .22 Bee, 2R Donaldson, .25-20, .32-20, .38-40 and .44-40. Not for the .222 Remington. It is a fine-grained, fast-burning powder, and measures very evenly in powder measures.

DuPont IMR No 4198. For the smaller-sized high-power cartridges like the 2R Donaldson, .219 Zipper, .222 Remington, .22 Savage H.P., .25-35, .30-30, and .303 Savage. Also suitable in some of the larger-sized cartridges for reduced and mid-range loads.

DuPont IMR No 3031. For small, medium, and fairly large rifle cartridges from .25-35 to .30-06, and also for some of the older large-bore cartridges such as .405 Winchester, .45-70, and .45-90. In the larger cartridges it is usually best with light bullets. Best for the .30-06 with 125 or 150 grain bullets.

DuPont IMR No 4064 and No 4320. These two powders are grouped together because they are very alike in their characteristics and adaptability although they differ in grain size. They usually, but do not always, require the same grain weight of charge. They have been used successfully in cartridges all the way from .220 Swift to .375 H&H Magnum, always with rather full loads. But in cartridges from .257 Roberts up, when heavy bullets are used, IMR No 4350 usually gives better velocity and accuracy.

DuPont IMR No 4350. This is the slowest-burning of DuPont canister powders and is generally adapted to the larger bottleneck cartridges with heavy bullets. It has become very popular because of the fine accuracy and high velocity it gives with moderate pressures, particularly in the .257 Roberts with 100 and 117 grain bullets, in the .270 Winchester with 130 and 150 grain bullets, and in the .30-06 with 180 and 220 grain bullets. It is not suitable for reduced loadings, and should be used with near maximum loads. In some loads the powder charge fills the case to the base of the bullet.

DuPont SR No 4759. For short and mid-range loads with either lead alloy or metal-cased bullets in a large variety of cartridges. A very excellent and clean-burning powder for reduced loads, particularly in the .257 Roberts, .270 Winchester, and .30-06 with either gas check or metal-cased bullets. No attempt should be made to attain high velocity with it, as with heavy charges it gives very high pressures, and is erosive.

IMR No 4895. A military rifle powder sold to members of the NRA by the Director of Civilian Rifle Practice at a moderate price. Also sold by B. E. Hodgdon, Merriam, Kansas, to handloaders generally. It is suitable for high-power cartridges from .219 Donaldson Wasp up to .30-06 In characteristics it seems to be midway between 3031 and 4320 powders. But different lots of it may differ considerably in their rate of burning, so that it has not been possible in this book to give exact charges for it.

The handloader should start with the grain weight of charge that has been recommended for 3031 powder, and exceed this charge with caution. In some cases one or two grains heavier than the charge for 3031 can be used. IMR No 4895 powder obtained from Hodgdon consists of many lots blended together, and once a charge has been established for it, it is safe to repeat it with the Hodgdon powder. In some cartridges it gives exceptionally fine accuracy with light and medium weight bullets.

Hercules HiVel No 2. For full and mid-range loads in many medium-size rifle cartridges with metal-cased bullets. A very fine powder that gives exceptional accuracy. The best powder for 300-metre loads in the .30-06. In large charges, however, it is liable to be rather erosive.

Hercules No 2400. A fast-burning powder designed for small cartridges like the .22 Hornet, .218 Bee, and .25-20. Should positively not be used in the .222 Remington. It is also one of the best powders to use in magnum pistol loads to obtain the higher velocities.

Hercules Unique. A fast-burning powder for use in small and medium calibres for reduced loads with lead or metal-cased bullets. Good for medium heavy loads in some revolver cartridges. The recommended charges should never be exceeded.

IMR No 4831. A slow-burning powder for medium and large cartridges with heavy bullets, supplied at moderate cost to handloaders.

Hercules Bullseye. The powder most used for standard and slightly reduced target loads in pistol and revolver cartridges, giving fine accuracy and almost no fouling. The charges required are very small, and care must be taken not to get two or more charges in the same cartridge. Do not attempt to get velocities higher than standard with it.

DuPont Pistol Powder No 5066. Very similar in all its characteristics to Bullseye, except a very slightly greater charge of it must be used to give the same velocity as Bullseye. The same precautions should be exercised to avoid getting a double charge in a cartridge.

Western Ball Powder Type C. At the time of going to press Hodgdon is supplying a lot of Ball Powder made by the Western Cartridge Company. As yet very little is known of its characteristics, although apparently it is giving some fine results in cartridges for which 3031 is a suitable powder. Because of the small ball shape of its grains it loads in very uniform charges when thrown in powder measures. Winchester-Western has announced availability of ball powder for handgun cartridges.

Canister lots of powder. The above powders are known as "canister lots of powder," that is they are put up in one pound or half-pound tin canisters or cans for sale to handloaders. They are the only powders that handloaders can buy at the present time, and they are the only powders about which definite handloading information is available.

Certain details about them must be understood so you will not confuse them with the lots of entirely different powder which the ammunition companies use in loading factory cartridges.

Powder is made in lots of many thousand pounds at a time. Each lot of the same general kind of powder has its own characteristics, its rate of burning, and the proper charge for each cartridge for which it is suitable. For a given lot these characteristics cannot be absolutely determined in advance.

Therefore each lot of powder differs at least slightly in its characteristics from other lots of the same powder.

Let us suppose the general type of powder is similar to DuPont IMR No 3031. Many different lots of this powder have been and are being made, each differing more or less slightly in its characteristics. One of these lots set aside as a *canister lot* has been called DuPont No 3031, and its characteristics have been made known to handloaders. Many other lots of this kind of powder have been manufactured, each having slightly different characteristics from 3031, and therefore these lots have been given different numbers.

These lots are sold only to the ammunition companies who use them in loading their factory cartridges, and the ammunition companies determine the proper charge for each cartridge and bullet, and control the loading with their chronographs and pressure guns.

When the supply of canister lot No 3031 nears exhaustion on the market, the DuPont Company sets aside another lot of this same kind of powder which has characteristics so close to that of the original No 3031, that it is practically identical, and this becomes the new canister lot and is known again as No 3031. Thus, while No 3031 has been on the market for many years, the present 3031 is practically identical with that original lot. This applies to all powders mentioned above, all being canister lots, except 4895.

Continental and local powders. With Norma powders, testing indicated that these powders will give a good accuracy level long past what is a desirable pressure level. The Hercules HiVel No 2 is a very bad offender in this respect, and this little caper is one labelled 'versatility' so watch for it. It is a rather good idea once this accuracy plateau is reached to search for the bottom edge and stop there. It means that cases, barrel and shooter all face markedly less wear and tear with consequent improved longevity.

Norma 200. The fastest of the Norma rifle powders is 200 and this is a very good powder for use in the smaller capacity cases with medium bores, and in the small hot shots like the .222 Rem. It is an excellent performer with the lighter bullets in cases like the .257 Roberts, where bullets of 60 and 70 grains weight are used.

Norma 201. Next up the scale is Norma 201, which is widely used in the medium bore rifles of about .30 calibre with cases like the .308 Win, .303 British and the larger bores like 9.3 mm with the lighter bullet weights. It is not of especial interest as 4740 is a more than adequate substitute.

Norma 202 has been dropped from the line and 203 is next.

Norma 203. This powder has the same range of cartridges as 4320 and 4064 in the DuPont line of IMR powders. It gives very good results in the smaller cases like the .250 Savage, and will give good velocities in the larger cases like the .270 with the 100 grain bullet and is ideally suited to the medium bores with larger cases like the .30 Springfield and the heavier bullet weights in the .303 British, .308 Winchester and 8x60 Mauser.

Norma 204 is the next in the line and closely resembles IMR 204 and so is an excellent powder for the .270 Win with the 130 grain bullet. It is fractionally slower than 4350 or rather will permit the use of slightly heavier loading without showing it as quickly. It is well suited to most of the high intensity cartridges having due regard to the problem of muzzle flash in the shorter barrels.

Norma 205. The latest addition to the Norma line. This powder is in a class of its own. It is only suited to heavy bullets in the smaller bores with very large belted cases, and will be received most enthusiastically by owners of .264 Winchesters, Magnums, 7 mm Remington Magnums, 7x61 S&H, and other such necked-down milk bottles.

In addition, Norma market a wide range of pistol powders, the range

for revolvers being labelled with an R prefix, self-loading pistols with a P prefix. P1 and R1 appear similar to Bullseye, while P2 has no American substitute, P3 appears similar to but quite a bit faster than 2400 and is intended for the 9 mm cartridge. R23 is used in the .38 Special for maximum loading in the heavy-framed guns and is the special powder for the .357 Magnum which operates at the very high pressure of 40,000 psi and of the larger bore .44 Magnum, which runs up to 34,000 psi since its much larger bore enables it to drive a heavy bullet of lower sectional density at lower pressures at equivalent velocities. This R23 powder is about 10 percent faster than 2400, and so in a burning bracket that restricts its use to handguns. It's rather too heavy for rifles, even the little Hornet.

4740. Looking at powders available here as canister or disposal sale powders we find 4740. This has been widely used in nearly every cartridge available. It is seen at its best in the .222 Rem and .222 Rem Magnum. It gives equally good results in the .250 Savage, with any bullet weight, gives excellent results in the medium bore .30 cal cartridges like the .308, and does a satisfactory job behind the lighter bullets in cartridges like the .257 Roberts, .243 Win, 6 mm Remington, and .270 having the same characteristics as HiVel 2, Norma 201, and IMR 3031. It gives good results in the reduced loadings needed for safe pressure levels in any .303 Conversion on the SMLE action using the .303 British case as a starting point.

4895. Available from time to time, it will give results similar to IMR 4064 and Norma 203. It is a good powder to work with, and has a well defined accuracy zone in the safe pressure level, without any sudden pressure. rise. This, too, is a most useful powder and is well adapted to the bigger capacity cases like the .257 Roberts, and the .270 Win and .280 Rem. It was the American powder for their .30 cal Springfield, for service loadings.

4831. A very slow powder, suited to the heaviest loadings in the high intensity field. Slower than 4530. It is most useful in loading cases like the 6 mm Rem with 100 grain projectiles, 120 grains in the .257 Roberts, as well as suiting all the Magnum class and the .270 and .280 with the heavier bullet weights. Capable of fine accuracy, but needs more attention to pick out this accuracy plateau than other powders due to its very slow burning. The percentage of difference in the loading density of a grain weight is less due to the very heavy charges that must be used. It does not run as freely through powder measure drop tubes as it might and the charges should be checked visually to make sure that all the charge thrown is in the case. There is no danger of a double charge being thrown as the normal charge will usually fill the case.

Some troubles may arise from the theoretical problems of compressed loadings, but in practice a slightly compressed loading does not seem to cause any problems either of pressure or of accuracy. Overseas troubles have cropped up with reduced charges of this powder giving some very odd results — with every indication of extreme pressure. We can advise that provided bullets are tightly crimped, and the rifle is not tightly throated, no problems will arise with slightly reduced loadings. There is absolutely no point in any really reduced loading with this powder as it has to have a heavy load to develop the ballistics that make its use worthwhile.

ICI Powders. There is no special merit in Cadet or revolver Neonite. These flake powders do not run readily in the drum type powder measures, and trouble occurs without even looking for it if any lubricant other than powdered graphite is used on the inside of case necks in resizing. Flake powders present a large flat surface which readily adheres to any grease in the neck of the case, and may not be scraped clear by the seating of a bullet especially of the gas check styling. In their characteristics, the ballistics given are surpassed by the Norma powders, and they present no special saving in outlay.

Nobel's Hornet Powder. Of the rifle powders, Nobel's Hornet Powder lies between 2400 and 4227 and gives excellent results in the smaller rifle cases like the .25-20 Special, .256 Winchester, .218 Bee, and cases around the 12 to 18 grain capacity figure. This is especially so in the smaller bores. It is highly accurate in the larger cases with reduced loadings and although it will not give the velocity in the Hornet that .2400 will, nor yet the low pressures of 4227 with the very reasonable velocities of the later powder, it is a very reasonable substitute. It is of value for the Magnum pistol loadings, although tending somewhat to muzzle blast, and this field is best filled by Norma 23.

Nobel's 2202. This is a powder that is only very slightly slower than Nobel's Hornet powder, performing in almost the same loadings as 4227 in the smaller cases, and to me offers no special merit as it is not as accurate to my mind as Nobel's Hornet in the .25-20, .32-20 and so forth and too fast for effective velocities in the .222 Rem. It may be regarded as a substitute for Nobel's Hornet although fractionally slower.

Nobel's 41. This is somewhat of a mystery, and its characteristics are not known to many reloaders due to its sporadic appearances on our market. It is slower than 4740, and is much the same as 4895, but we found it very sensitive to small changes in loading density. In weighed charges it is capable of fine accuracy, but is not as useful a powder to the reloader as 4740 although in its heavier loadings it will give slightly higher velocity, at a much higher cost. It is not in the same field as Norma 204. It could substitute for Norma 203, although it lacks the latter's versatility.

Other powders available here include the Israeli ball powders. These are numbered 655 and 656. The 655 is a good powder for use in the .243 and 6 mm Remington, and is a useful substitute for Norma 203. It runs well through measures and meters very accurately, and is well suited to all cases in the medium high density loading class. It gives excellent accuracy, and will give very fair results in the .222. Its stablemate 656 is a powder to be watched with loving and peculiar care. It is some ten percent faster than 2400, and due to its coating does not ignite readily in revolver cartridges, but is too quick for any rifle cartridge including the .22 Hornet. It would be quite easy to make an error in ordering with the numbers so close together, and has blown at least one .222 rifle.

Powder in Factory Cartridges. As explained above, the ammunition companies do not load their factory cartridges with canister lots of powder. They give their specifications for powder for a certain cartridge to the powder companies who turn them out a lot of powder, possibly many thousand pounds, as close to those specifications as they can. The ammunition companies then determine the proper charge of this powder for all the cartridges in which they wish to load it, controlling its loading to give standard velocities with pressures within their safety limits.

Thus if you open up a certain factory cartridge and look at the powder, and it looks like 3031, beware! It is not 3031, and the amount of weight of that powder is no good guide as to the amount of 3031 to use in handloading that cartridge to get results similar to those of this factory cartridge. *Thus neither the amount nor the appearance of the powder found in any factory cartridge must be taken as a guide for handloading.*

It is only commonsense that if you have a supply of old .30-06 ammunition, with 150 grain metal cased bullet, and find that it is loaded with 45 grains of a certain powder, that you can salvage that powder, and use it again in a 45 grain load to handload a fresh batch of 30-06 cases with 150 grain metal cased bullets. It might even be safe to assume that if you wished to load 180 grain bullets in your new batch of ammunition that you would be safe in using, say, 41 grains of this identical powder.

But further than that it is not safe to go. It would not be safe, for example, to use that powder in loading the .270 Winchester cartridge unless you had a chronograph and pressure gun to determine the load, or unless

you started with a very small charge, and worked the load up a grain at a time, watching for indication of excessive pressures.

Selecting the Loading. One of the oldest techniques for developing a load is to pick a very moderate starting point for a powder charge and then work up the load a grain at a time until the accuracy started to fall off. With many powders this technique works very well, and since it gives a safe loading as well as the most accurate one for the cartridge it has been widely used, but it is applicable only to the stronger actions capable of standing up to operating pressures in the 50,000 psi class. Try this with your favorite lever, unless it is a late model 99 or an 88 and you've got a piece of junk on your hands if you're still able to appreciate it. The same comment applies to the older variations of the Mauser and Mannlicher Schoenauer rifles, and our own SMLE. If you must experiment with these, let someone else do it.

While this technique will give superlative results with 4740 which is very similar to IMR 3031, HiVel 2, and Norma 201, it is not so readily applicable to American canister powders and even less to Norma powders. The right powder for any loading is that which will give the lowest breech pressure with the highest velocity at the muzzle. To some degree this statement must be modified now to take into consideration the current trend to shorter barrels. Bench rest rifles, which once sported 28 inch tubes are reappearing with 18 inch barrels, but of very heavy diameter. The bench rest shooter is not interested in great striking energy since it requires little energy to punch through a paper card, but only in extreme accuracy.

A suitable powder must burn inside the barrel, otherwise a terrific boom as a large amount of unburnt powder hits the open air does no more than upset the bullet flight and blind the shooter preventing a follow-up shot in the poor light in late afternoon shooting. So for the hunter the best plan is to take what powders are available in the powder capacity that he is interested in and find out where he gets his best accuracy figure, and then try the loading after the light fails. This is one of the reasons why I have always used a small cartridge for late evening and night shooting.

Proper charges of powder. While all of these explanations are necessary to prevent beginners from doing dangerous things with powder, no reader need be confused about modern smokeless powder.

CHARGING CASES WITH POWDER

Your cases are now all chamfered, sized and primed, ready to be charged with powder. You are going to load your cartridges with a certain weight and kind (lead alloy, lead alloy with gas check, or metal cased) of bullet.

Select the charge you are going to load; that is the kind of powder and the weight of the charge in grains. Note the number of grains you will use on a sheet of paper. Long experience in handloading has shown that it is very desirable to check the load twice. Anyone is liable to make a mistake in reading a table, reading the wrong line or column, and we have known of a number of mistakes being made in just this way.

Powder is measured by grains. Charges of powder are indicated by grain weight, which is the foundation of all systems of weights used in the United States and Britain except the metric system. There are 7000 grains in 1 lb, or 437½ grains in one ounce, Avoirdupois.

Ways of measuring the charges. There are three ways of measuring the charge to be placed in each cartridge case. (1) By dipping the charge out of a reservoir of powder with a small dipper which holds just the right amount. (2) By mechanically measuring each charge with a special powder measure. (3) By weighing each charge on an accurate scale. The most practical method is a combination of (2) and (3).

Dipping Powder. A powder dipper is easily made by filing off a cartridge

case until it holds just the right amount of powder as verified by an accurate scale, then soldering a short wire handle to this dipper. Dippers can also be bought at nominal price from some dealers in loading tools (Ideal). The powder should be poured out of the canister into a can or box in which it will bulk up in a pile at least two inches deep. The dipper is inserted down into the bottom of the pile, mouth up, and brought up to the surface of the pile so that the powder will fill the dipper each time with the same pressure. Keep the pile at the same uniform depth. The dipper will now be full to overflowing with powder. Take a card (postal or visiting card) and gently scrape it across the mouth of the dipper to level off the powder just even with the top of the dipper. Place a small funnel in the mouth of the cartridge case, and pour the powder from the dipper into the cartridge case, taking care that no powder is spilled.

This method is crude and not very accurate, and its sole recommendation is that you don't have to buy a powder measure or scales. Dipper charges will vary from dip to dip about one to three grains, depending on the weight of charge and the kind of powder being measured. Therefore if this method is used your charge should be at least two grains lighter than the heavy charge given in the table for the bullet you are loading.

Charging by powder measure. A number of different mechanical measures for measuring powder are available — Ideal, Belding & Mull, R.C.B.S., Redding, etc. A table comes with each which shows where to set the measure to cause it to throw a certain number of grains of a certain powder. You first fill the reservoir of the measure almost to the top with powder.

Set the scale at the proper graduation, hold the empty cartridge case under the tube opening at the bottom of the measure, pull down the handle of the measure, and the charge of powder in the receptacle will fall into the cartridge case. Then lift the handle of the measure and the receptacle again fills with powder ready to charge another case. There is often a little knocker on the side of the measure and when you have lifted the handle you should flick this knocker up, thus jarring the measure slightly and settling a uniform amount of powder into the receptacle.

The reservoir should be kept at least half full of powder at all times to give a uniform reservoir pressure which will further assure a uniform charge settling into the receptacle.

These measures do not throw an absolutely accurate series of powder charges. With most of them successive charges will vary plus or minus about .2 grain with the finer powders, and about .4 grain with the coarser grained powders. The greatest variation from lightest to heaviest charge in loading 100 cases with coarse grained powder would thus be about .8 grain.

You cannot be quite certain that the measure set at the graduation given in the table accompanying it will throw the corresponding charge of powder. There may be an error of one or two grains either way. Thus if you set the measure by the table to throw, say, 36 grains of a certain powder, it may actually average 37½ grains or perhaps 34½ grains. If it averages 37½ grains of a coarse grained powder, some of the charges may weigh 37.1 grains, and some 37.9 grains. Therefore if you wished to load a maximum charge of 36 grains it would not be safe to use the measure in this way. In fact if you set the measure by the table that accompanies it you should not approach within about 1½ grains of any maximum charge given in the table of loads in the back of this book.

Many powder measures have tubes projecting from the bottom of the measure that funnel the powder into the cartridge case. Two of these tubes are usually furnished, one for cases of .25 calibre and larger, and one for .22 calibre. When using coarser grained powders in the .22 calibre tube the grains will occasionally "bridge" in the tube, making an obstruction past which no powder, or only a small amount of powder drops into the cartridge case.

The tube thus fills with powder, and at the next throw it may dump a charge and a half or a double charge into the case. This is an exceedingly dangerous matter that must be watched for constantly, but the system of inspection given below will always discover it. Also, by looking into each case after the powder has been loaded to see that it stands at a uniform level, any failure to deliver the correct charge will be instantly detected.

These little troubles are mentioned merely as cautions. There is almost never any trouble at all except in the unavoidable slight variation in successive charges, and these measures are very efficient.

The Bolding and Mull powder measure operates on a slightly different principle. The measuring receptacle is entirely separate from the reservoir. You set the receptacle for a certain charge, place it under the bottom opening of the measure, and when the handle is operated the receptacle fills with powder. Then you place a small funnel over the mouth of the cartridge case, and pour the powder from the receptacle into the cartridge case, and as you see every grain go into the case there can be no accidental variation other than the very small variation in the receptacle content. The B&M measure is thus slightly slower to operate than the other measures. You can perhaps charge about ten cases a minute with it as compared with about 15 cases with the measures that dump directly into the cartridge case.

The best procedure is: Have a loading block, containing all the primed cases, mouths down and primer up. Take a case from the block, fill it with powder, then return the filled case to its hole in the block, or to another block, mouth of the case up so it will not be knocked over and no powder will spill out. When all cases in the block have been charged with powder, take the block into a good light, run the eye along the rows of cases, and see that the powder stands at a uniform depth in each and every case.

Charging by measure and scale. This is the method used by practically all experienced handloaders. The powder measure is set as before, but instead of throwing a first charge into a case it is thrown on to the pan of the powder scale which has been previously set to weigh the exact charge desired. If the charge as thrown by the measure does not balance correctly on the powder scales, the setting of the powder measure is changed just slightly, and this is continued until the measure throws at least two consecutive charges that balance and weigh correctly on the powder scales.

Thus you really set the powder measure by means of the powder scales and not by the scale on the measure. Then you can go ahead and throw directly from the measure into the cartridge cases. As an added check it is well to throw every 25th or 50th charge on the powder scale to see that there has been no slip or variation.

In this manner you are quite certain of filling the cases with the correct charge of powder within the slight unavoidable variation of the measure, which, as stated above, practically never varies more than .4 grain above or below the normal charge. Such slight variation in the charges occasions less of a variation at the target than the unavoidable errors of aim with iron sights or lower power hunting scopes.

Weighing each powder charge. This method of charging the cases, while it is, strictly speaking, the only really accurate method, is nevertheless so slow that ordinarily it is used only in loading cartridges for 1000 yard target shooting, for target matches that are to be hotly contested, and for certain experimental firings. Each powder charge is weighed out separately on the scale before it is funnelled into its cartridge case. Usually only about three or four cases a minute can be thus charged.

Set the powder scales at the exact charge desired. Set the measure at about 1½ grains less than the charge desired. Throw from the powder measure on the pan of the scale (usually taking the pan off the scale and holding it under the measure so that the powder piles up in the centre of the pan and does not spill, then place the pan on the scale again).

Then have a cartridge case (of a calibre other than the one you are loading to avoid any possible confusion) filled with powder. and holding it

over the pan, tap it lightly with the finger and thus flick a few grains of powder on to the pan, until the scale just balances. Then lift the pan off the scale, and pour into the cartridge case through a funnel.

There is a rather expensive electronic powder scale made by the Gunderson Instrument Company which will weigh powder charges in about seven seconds in 0.1 grain steps, accurate to plus or minus .05 grain.

Truth compels us to say, however, that innumerable tests have shown conclusively that powder charges thrown from a good measure result in just as good accuracy as where they are individually weighed to within one-tenth grain or less variation. Thus there is no real necessity for going to the time-consuming operation of weighing each individual powder charge.

At first thought this does not seem reasonable, but the variation in ignition of each individual primer, plus the slight but unavoidable variation in powder capacity of each individual case, plus the slight variation of tension of the bullet in the case neck, plus slight variations in each individual bullet, make an algebraic sum which is not materially reduced by an absolutely uniform weighed powder charge.

Powder scales are sold by almost all makers of reloading tools. The best have graduated beams and counterweights and are most convenient and faster. With care they are all accurate to within about 1/10th grain. Take care that their trunnions do not get dulled, keep a bullet of precisely known weight with them to verify them from time to time, and when using them see that they are levelled on the loading bench.

Economy. If one has to economise in the purchase of his tools it is suggested that probably the best plan would be to purchase a cheap scale and dispense with the powder measure. However, this means that only about three or four cases a minute can be charged, and probably sooner or later the handloader will add a powder measure to his outfit to save time.

Compressed charges. In almost all cases the powder charges recommended for various cartridges and weights of bullet will not completely fill the cartridge case with powder up to the base of the seated bullet. Usually even the maximum charges recommended for rifle cartridges will only fill the case to within $\frac{1}{8}$ to $\frac{1}{4}$ inch of the base of the bullet. With mid and short range rifle loads and pistol loads often the powder does not fill the case more than about half full. All this is entirely normal. Heavier loads of that powder might give excessive and dangerous pressures. There must be this air space for safety in these loads. Powder should not fill the case full, nor be compressed in seating the bullet.

However, there are exceptions to every rule. Some charges of 4350 and 4831 powder may fill the case almost to its mouth, and when the bullet is seated the powder will be compressed, and yet the charge, if a recommended one, will give normal pressure and good results.

Indeed, an occasional proper charge of these powders may fill the case and overflow. To get such a charge into the case and seat the bullet, pour the powder into the case very slowly through a funnel with a long tube. The grains will settle themselves more compactly in this manner and you can get the whole charge in the case.

But be cautious when you first begin to fill your cases with powder. If you find that the charge fills the case right up to the base of the bullet, or overflows the case, check your load in the table, and also check your powder measure and scales to be certain that you have not made a mistake.

Emptying the powder measure. When all the cases of the lot being loaded have been filled with powder, do not empty the powder remaining in the measure back into the canister from which it came. It is usually best not to disturb the measure or the scales until you have seated the bullets into the charged cases because a case does get knocked over now and again. If the measure and scales have not been disturbed it is easy to fill that case with powder again.

CHAPTER TEN

Seating Bullets

ALL the cases have been charged with powder, and placed upright in the loading block, the next and final step in handloading our cartridge is to seat the bullet evenly, straight, and to the correct depth in the neck of the case.

To seat the bullets, the bullet seating chamber is first screwed into the loading tool. We will suppose you have not seated bullets before in your tool, therefore the bullet seating chamber must be correctly adjusted. If you examine a bullet seating chamber you will see that it is composed of two parts — the chamber into which the case fits, and the bullet seating stem in which the bullet fits. This last part pushes the bullet down into the case neck. (Sometimes there is a third part, the crimping stem or ring, which we will deal with later.) First screw the bullet seating stem almost out of the bullet seating chamber proper. Then screw the complete chamber into the reloading tool. Try an empty case in it, and screw the chamber until, when you close the lever of the tool, thus causing the case to enter the chamber, the case can be felt coming up against the end of the chamber. Then screw the chamber out about a half turn so that when the lever is closed the case does not come up to quite the end of the chamber by perhaps $\frac{1}{32}$ in. Then screw down the clamping collar on the outside of the chamber until it comes against the shoulder of the tool, and clamp it there with its set-screw, thus retaining the chamber in proper adjustment in the loading tool.

Always screw the die or chamber into the reloading tool until it comes up against the clamping ring, no matter what bullet you are seating.

The next problem is to screw the bullet seating stem into the die proper so it will seat the bullets into the cases to the exact depth you wish. We will first take up the seating of the bullet to the same depth that that type of bullet is seated in a factory-loaded cartridge. In this Outdoors Handloading Guide, under each cartridge, you will find the "standard cartridge length". This is usually the standard overall length of the cartridge when it is loaded with the heaviest bullets that are generally used with it, and it is also the longest length that will operate through the magazine of standard rifles. However, there are some cartridges that the factories load with short, light bullets, and these cartridges have a shorter than standard overall length.

Suppose, for example, you wish to seat a 150 or 180 grain pointed bullet to standard overall length in a .30-06 case. The easiest way to seat the bullet seating stem is to take a factory cartridge loaded with a 150 or 180 grain pointed bullet (they are all the same seating length), place its head in the shell holder of the reloading tool, operate the handle and raise the cartridge all the way into the bullet seating die, then screw the bullet seating stem down against the bullet, and tighten the collar on the stem. For other seating depths you simply adjust the bullet seating stem accordingly, by trial and error.

Now you are ready to seat the bullets.

Take a case that is primed and filled with powder, and holding it upright, slide its rim into the rim slot in the cartridge case holder of the loading tool. Then take a bullet and place or balance it on the mouth of the case, base of the bullet centred in the mouth. If you rotate the base of the bullet just slightly as you place it on the case mouth, a little as you

would start to cork a bottle, it will centre there, and the bullet will stand upright in position to seat down into the neck of the case. There is a little knack of thus placing and balancing the bullet on the case mouth so it will slide into the neck smoothly and evenly when the bullet seating stem begins to press down on it. This knack is easily learned in three or four trials.

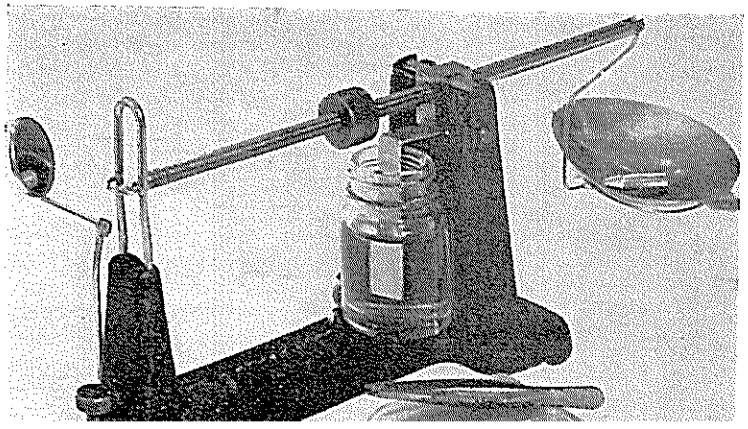
(Of course, you cannot actually start the bullet into the mouth of the case with your fingers because the base of the bullet is slightly larger than the inside of the neck of the case, perhaps about a thousandth of an inch larger.)

The bullets should seat easily in the case necks — just a gentle pull-up on the handle of the tool — no force. If you feel a bullet apparently catch on the mouth of a case and refuse to start in smoothly, do not attempt to force it in. Lower the handle, thus withdrawing the case and bullet from the chamber, rotate the bullet slightly on the case mouth, thus giving it a more perfect and central fit in the mouth, and try again. If the bullet does not start to slide into the case neck easily this second time probably something is wrong. The case may be slightly deformed at the mouth, or the bullet may be too large, or you may be trying to force a bullet with a very square base into a case mouth that has not been chamfered. A little close inspection will show what is at fault. Trying to force a bullet in will crumple or mash down one side of the neck of the case, and distort the base of the bullet, ruining both.

For the finest accuracy it is highly desirable that the tension on the bullet in the neck of the case be as uniform as possible. This is called "bullet pull," that is the number of pounds of direct pull that it takes to pull the bullet out of the case. Before you have seated many bullets you will become aware of the gentle, quite uniform pressure on the handle of the loading tool necessary to seat the bullet. Whenever this pressure is markedly easier or harder, thus indicating lighter or greater tension on the bullet, lay that cartridge aside for a sighting shot or practice. All those that seat with uniform pressure can be used for record firing, competitions or hunting.

Bullet seating stems are formed to just fit the point of the particular bullet you are loading. That is, the stem that fits over the bullet may be shaped to fit almost a flat point, a round point, or a sharp point bullet. In recent years, however, practically all bullet seating stems have been made so that they will seat bullets with variously shaped points without deform-

Franklin Scale.



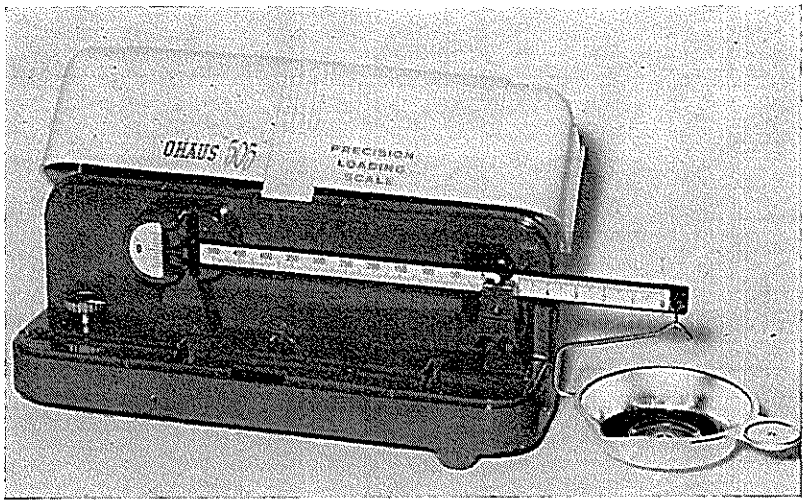
ing the point. But do not attempt to seat a sharp pointed bullet with an old type stem made for a flat or round point bullet or you will deform the sharp point of that bullet. Usually you should order bullet-seating dies with stems to seat sharp-pointed bullets. These will usually seat all bullets correctly. For tubular-magazine rifles, however, the stem should be ordered to seat standard flat-nose bullets, and pistol dies should be ordered with stem to fit the particular bullet you are going to load.

Seating depth of bullets. The depth to which a bullet is to be seated in the case depends on a number of factors. First, we may wish that the cartridge be short enough in its overall length so it will operate smoothly through the magazine of the standard rifle of that calibre. For example, for .30-06 and .270 WCF cartridges it is 3.35 in. and for .257 Roberts 2.75 in. and for .250-3000 Savage 2.52 in. Adjust the bullet-seating die so it seats the bullet to just this depth. Some rifles, however, have magazines that are longer than standard, and sometimes for these, bullets can be seated to greater than overall length with advantage. But generally, if the cartridge intended for a magazine rifle is seated to greater than standard overall length, then if loaded directly into the chamber, it cannot be extracted and ejected without firing unless the bolt is first withdrawn from the receiver. But of course such long cartridges can be used in single-loading only.

It will be obvious that it will be impossible to seat very short, light bullets, like 110 and 125 grain .30 calibre bullets, to standard overall length, because not enough of the base of the bullet will be in the neck of the case for security. The base of .22 calibre bullets should always be inserted at least .18 in. deep in the neck of the case for security, .25 calibre at least .23 in., and .30 calibre at least .30 in. .deep.

When it can be done, it is sometimes desirable that the bullet be seated far enough out of the case so that, when the cartridge is fully seated in the chamber of the rifle, the ogive (curve of point) of the bullet just touches the lands of the rifling in the bore. This long seating sometimes results in greater accuracy. The bullet is trued up in the chamber and bore by the lands, and it does not have to jump through the bullet seat into

Lyman's Ohaus 505 precision reloading scale. It folds into a very neat, compact package. Cost here £11.2.6.



the rifling, and likely slightly deform itself. A cartridge with bullet seated to make contact with the lands may not work through the magazine, but it can be handloaded singly into the chamber. Seating the bullet to thus make contact with the lands is done by adjusting the depth to which the bullet-seating die is screwed into the loading tool, and trying the cartridge in the chamber, until you get a length that, when you extract the cartridge, just shows a very slight mark or depression on the ogive of the bullet where the lands pressed into it. Do not seat to such a depth that the lands impress themselves deeply on the ogive. Cartridges loaded with such a long overall length are likely to press the bullet so deeply into the lands and that if you cannot extract them without firing, the bullet may remain in the bullet seat, and the powder may be spilled in the action.

This long seating of the bullet to make contact with the lands should be approached with caution. Such long seating sometimes increases the breech pressure, and gives greater variation than normal in velocities. It is better to reduce the powder charge for such cartridges by one grain. Such reduction will usually result in the best accuracy.

When bullets are seated to greater than standard overall length, this automatically increases the powder capacity, and with standard powder charges slightly lowers both pressures and velocities. It is then sometimes possible, and safe, to increase the standard powder charge a grain or two, thus restoring standard pressures and velocities, or indeed, occasionally obtaining a few feet per second additional velocity. But such increases in powder should be approached with caution, watching for any sign of abnormal pressure.

Seating depth and pressure. Generally speaking, the maximum loads to which we refer are for cartridges with bullets seated to standard depth or standard overall length. If the bullet is seated deeper than this, thus decreasing the powder space and air space within the case, and giving greater density of loading, then the pressure is increased, possibly to the danger point. On the other hand if the bullet is seated to land-contact overall-length (particularly a light or short bullet) the powder and air space are increased, the density of loading is lowered, and the pressure is reduced. In such an event it may be possible to load a slightly greater charge of powder within pressure limitations, thus increasing velocity.

Example: The standard overall length of the .257 Roberts cartridge is 2.75 in. If we use a 100 grain Moffat bullet (a two-diameter bullet) seated to land-contact overall-length the actual length of the loaded cartridge will be about 3.03 in. Loaded to this length it is practical to use a powder charge of 47 grains of duPont No 4350 powder which is within safe pressure limits.

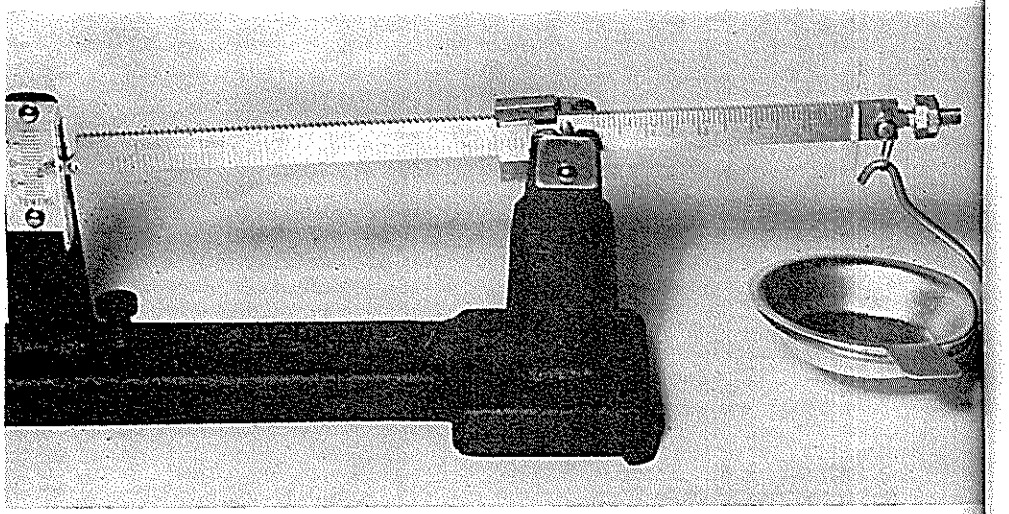
But if we seated this bullet, or any other 100 grain bullet to standard overall length (2.75 in.) and then used 47 grains of 4350 powder we would have an excessive charge and probably dangerous pressure. A charge of 47 grains of this powder fills the .257 Roberts case full to the base of the 100 grain Moffat bullet seated to an overall length of 3.03 in., with no air space, giving what is termed 100 percent density of loading.

Crimping the bullet. So far we have discussed only seating the bullet friction tight in the properly sized neck of the case. This is the common and best practice with all bolt action rifles and single shot rifles.

However, this friction tight fit will not hold the bullet securely and satisfactorily in tubular magazine rifles, and revolvers. With tubular magazine rifles the mouth of the case must be crimped into the bullet to prevent the bullet being driven deeper into the case when the recoil of the rifle forces the column of cartridges in the magazine hard against the bullet.

With tubular magazine rifles we must use flat pointed bullets so that the sharp point of the bullet of one cartridge is not against the primer of the cartridge ahead of it in the tubular magazine. The sharp point of a pointed bullet might set off the primer of the cartridge in front and cause an explosion in the magazine.

Crimping revolver bullets is necessary to give enough initial pressure



A Redding powder scale, one of a moderately priced range put out by Lyman which is quite satisfactory for all types of reloading. Australian cost, £8.4.9.

to make the relatively small powder charge with low density loading and considerable air space ignite and burn correctly. It is necessary to prevent the bullets of cartridges in the chambers from jumping farther out of their cases when the revolver recoils.

Many metal-cased bullets, particularly those for rifles with tubular magazines, have cannelures pressed into their jackets. If you are crimping the case on the bullet you naturally adjust to crimp in this cannelure. But if you are loading the bullet friction-tight in the case, you pay no attention to this cannelure, but just seat the bullet to the desired seating depth.

Adjusting the crimping shoulder. It has already been seen that when bullets are to be crimped in case the mouth of the case is slightly belled. Most metal cased bullets that are designed for tubular magazine cartridges and most lead bullets designed for both rifles and revolvers have crimping cannelures or grooves in them.

To seat and crimp the bullet we must use a bullet seating chamber that has a crimping shoulder or crimping stem. The bullet seating chamber is adjusted in the tool as described earlier and both the crimping shoulder and bullet seating stem are then screwed in by trial and by degrees until the mouth of the case is crimped slightly but firmly in the crimping cannelure of the bullet.

The bullet seating chamber, its crimping shoulder and the bullet seating stem are most easily adjusted by seating a factory crimped cartridge in the case holder of the loading tool, and then screwing down on it first the bullet seating chamber proper with its crimping shoulder, and then the bullet seating stem.

Try the cartridge case with its powder charge and the bullet balanced on the mouth of the case, and see if it seats and crimps the bullet properly. Adjust it until it does. It is easy to balance and fit the bullet on the mouth of a belled case because the bell mouth permits the base of the bullet to enter just slightly into the case mouth.

The accuracy of all cartridges depends greatly on the tension with which

the base of the bullet is held in the case neck, so take pains to get these correct. It is just a matter of trial adjustments.

Seating bullets in automatic pistol cases. Here the flat mouth of the case abutting against the front end of the chamber provides the stop that prevents the rimless case from entering too far into the chamber, supports the case against the firing pin blow, and determines the headspace measurement. Thus the extreme edge of the mouth of the case must be quite square and even.

The bullet is held friction tight in the case by having the neck of the case sized so that it measures several thousandths of an inch smaller inside than the diameter of the bullet. To have the bullet seat evenly and centrally in this case the bullet must be slightly rounded on the base. Bullets are seated to standard overall length, no crimp. Uniform tension of the bullets in the case necks is necessary for the best results. If bullets seat with less or greater pressure than normal use those cartridges for sighters or practice.

Packing. All of the cartridges having been completely loaded, it only remains to pack them properly and label them so as to identify the loading. While it is common practice to pack handloaded cartridges in the standard 20 round paper cartons in which factory cartridges are packed, these cartons are not ideal.

If stored in a damp place the cardboard may absorb moisture and corrode the outside of the cartridges. It is better where one can conveniently do so, to pack handloaded cartridges in wood boxes, even in cigar boxes from which paper linings have been removed. Cigar boxes can be reinforced with tape to make them much stronger.

Then the box should be labelled to show the exact loading of the cartridges it contains. These data may be written on the outside of the box or carton, or they may be written on a label pasted on the outside or they may be written on a card which is packed inside with the cartridges. All of the following data are usually desirable:

For use in weapon No.....
Primer .....
Powder, kind .....
Powder charge: Grains .....
Bullet ..... Grains .....
Bullet diameter .....
Case necks expanded to .....in.
Overall length .....
Cases previously fired .....times
Loaded (date) .....

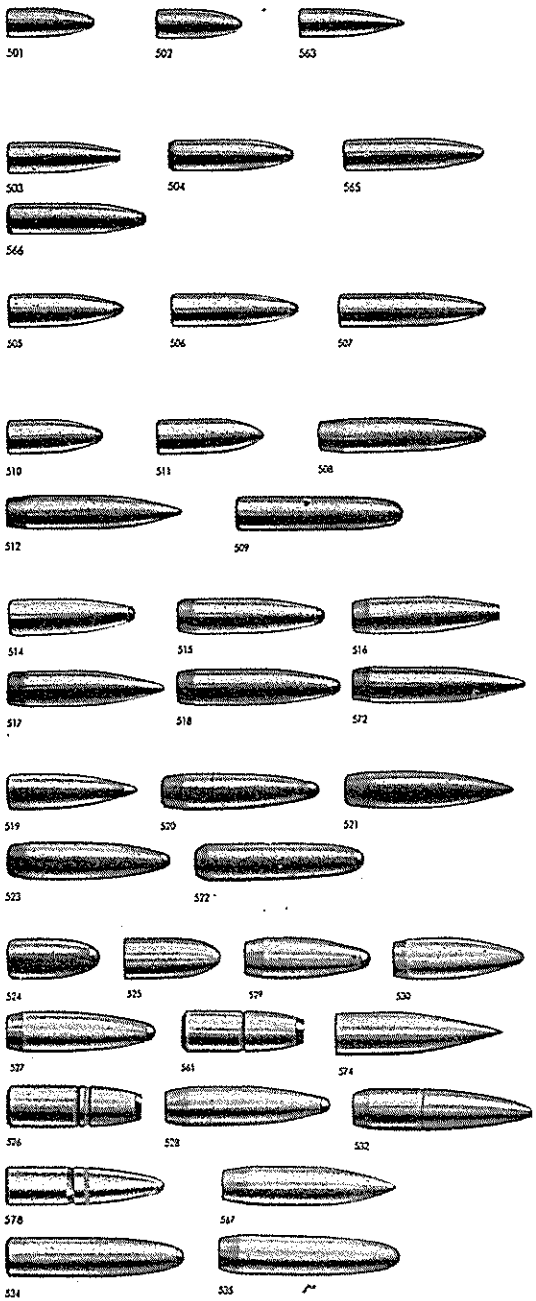
No mistake can then be made with these cartridges next week or five years from their loading date.

Bullet pulling. A handloader sometimes wishes to pull the bullets out of loaded cartridges, and substitute other bullets or powder. Or he may wish to load the cases with some other load. Many of the reloading tool makers sell bullet pullers which are used in the reloading tool in place of the bullet seating and other dies. The cartridge is run into the bullet puller, the jaws of the puller are clamped on the bullet, the lever of the loading tool is reversed, and the bullet is pulled straight out of the case.

The case is then very much as though it had been fired. That is before it can have another bullet seated in it, it must be chamfered at the mouth (if it has previously been crimped), it must be neck resized and then expanded to the proper inside neck diameter for the new bullet.

Bullets that have been carefully pulled from cases in this manner are scarcely injured. They may not be quite good enough for fine target shooting, but they can usually be loaded and used again for ordinary practice or sighting shots.

NORMA PROJECTILES FOR HUNTING CALIBRES



.22 caliber - .244" diameter

Index no.	STYLE	Bullet weight grains	Bullet weight grams
501	Soft point semi pointed	50	3.2
502	Full jacket semi pointed	50	3.2
563	Soft point pointed	55	3.6

6 mm - .243" diameter

503	Hollow point	75	4.9
504	Soft point semi pointed	90	5.8
565	Full jacket semi pointed	100	6.5
566	Soft point semi pointed	100	6.5

.25 caliber - .257" diameter

505	Soft point pointed	87	5.6
506	Soft point pointed	100	6.5
507	Soft point pointed	120	7.8

6,5 mm - .264" diameter

510	Soft point semi pointed	77	5.0
511	Full jacket pointed	93	6.0
508	Soft point semi pointed boattail	139	9.0
512	Full jacket pointed boattail	139	9.0
509	Soft point round nose	156	10.1

.270 caliber - .277" diameter

514	Soft point semi pointed	110	7.1
515	Soft point semi pointed boattail	130	8.4
516	Hollow point boattail	130	8.4
517	Full jacket pointed boattail	130	8.4
518	Soft point semi pointed boattail	150	9.7
572	Full jacket pointed	150	9.7

7 mm - .283" diameter

519	Soft point semi pointed	110	7.1
520	Soft point pointed boattail	150	9.7
521	Full jacket pointed boattail	150	9.7
523	Soft point pointed boattail	160	10.4
522	Soft point round nose	175	11.3

.30 caliber - .308" diameter

524	Soft point round nose*	110	7.1
525	Full jacket round nose*	110	7.1
529	Soft point semi pointed boattail	130	8.4
530	Full jacket pointed boattail	130	8.4
527	Soft point semi pointed boattail	150	9.7
561	Soft point flat nose	150	9.7
574	Full jacket pointed boattail	150	9.7
526	Soft point flat nose	170	11.0
528	Soft point semi pointed boattail	180	11.6
532	Hollow point boattail	180	11.6
578	Soft point semi pointed "Dual-Core"	180	11.6
567	Full jacket "Match"	187	12.1
534	Soft point round nose	220	14.2
535	Full jacket round nose	220	14.2

* = .30 US Carbine bullet

.303 caliber - .311" diameter

Index no.	STYLE	Bullet weight grains	Bullet weight grams
536	Soft point semi pointed	130	8.4
564	Soft point semi pointed	150	9.7
537	Soft point semi pointed boattail	180	11.6
538	Soft point round nose	215	14.0

8 mm - .318" diameter

573	Soft point round nose	159	10.3
580	Full jacket round nose	159	10.3
539	Soft point round nose	196	12.7
579	Full jacket round nose	196	12.7

8 mm S - .323" diameter

541	Soft point semi pointed	123	8.0
542	Soft point round nose	159	10.3
581	Full jacket round nose	159	10.3
540	Soft point round nose	196	12.7
543	Full jacket round nose	196	12.7
544	Hollow point boattail	198	12.8
545	Full jacket boattail	198	12.8
546	Soft point round nose	227	14.7

.35 caliber - .358" diameter

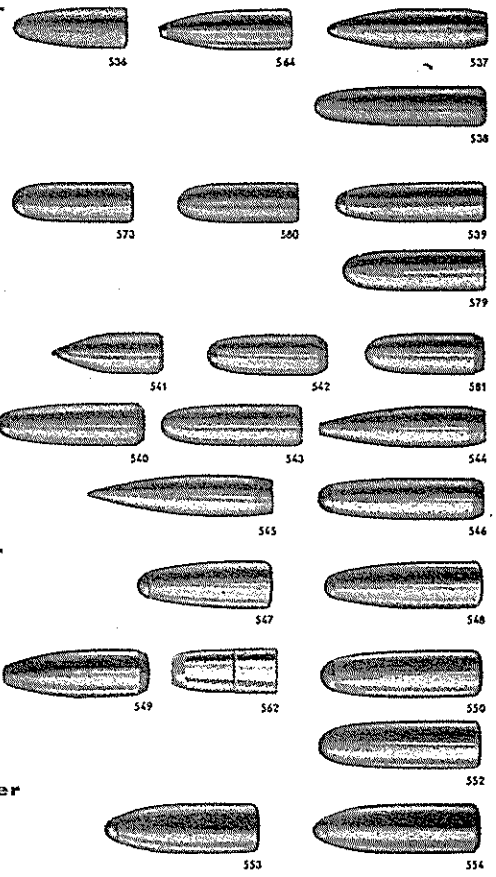
547	Soft point semi pointed	200	13.0
548	Soft point semi pointed	250	16.2

9,3 mm - .365" diameter

549	Hollow point boattail	232	15.0
562	Soft point flat nose*	200	13.0
550	Soft point round nose	286	18.5
552	Full jacket round nose	286	18.5

.375 caliber - .375" diameter

553	Soft point semi pointed	270	17.5
554	Soft point semi pointed	300	19.4



Revolver and pistol bullets

.30 (.32) caliber - .308" diameter

555	Full jacket round nose	77	5.0
556	Full jacket round nose	93	6.0
560	Soft point round nose	93	6.0

9 mm - .355" diameter

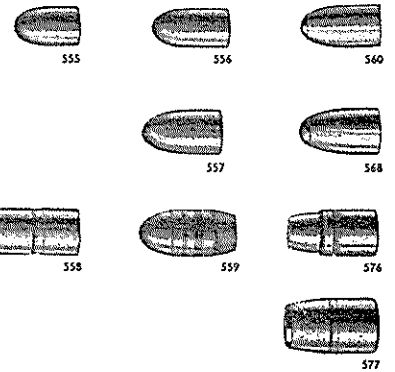
557	Full jacket round nose	116	7.5
568	Soft point round nose	116	7.5

.357 (.38) caliber - .357" diameter

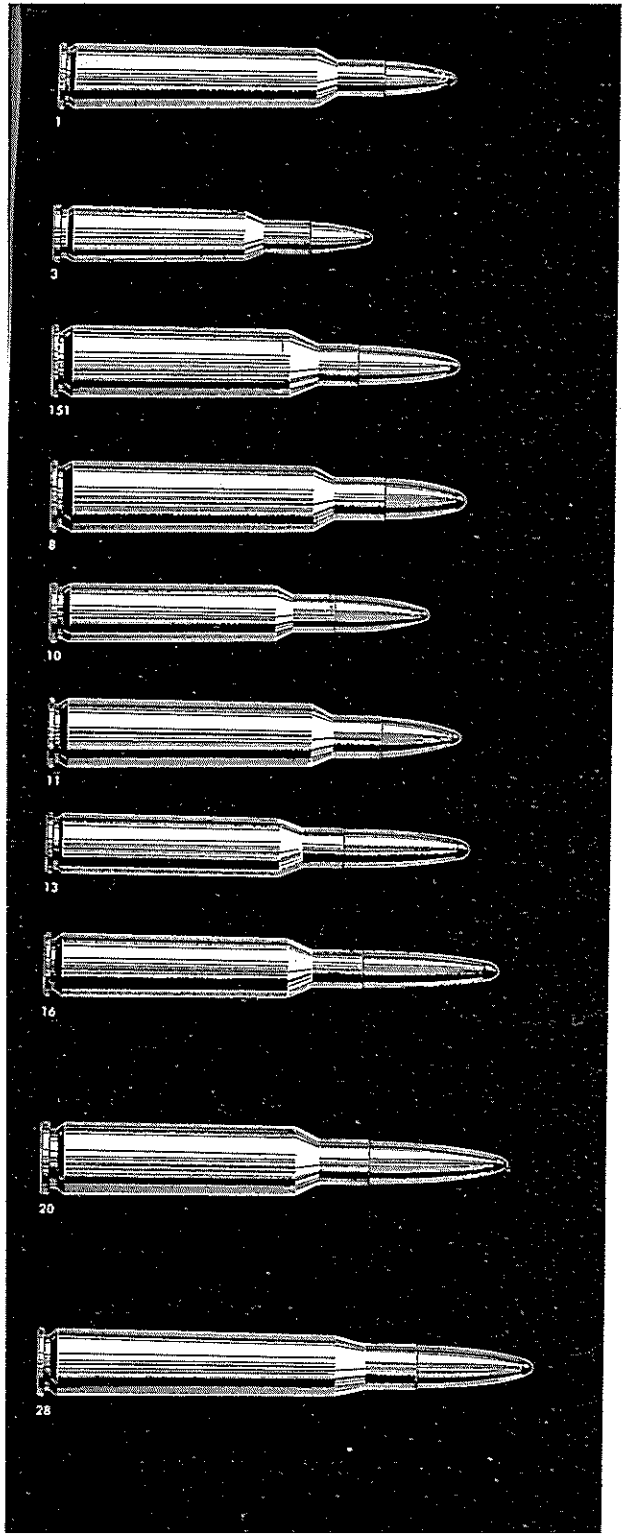
558	Lead wadcutter	148	9.6
559	Lead round nose	158	10.2
576	Soft point flat nose	158	10.2

.44 caliber - .430" diameter

577	Soft point flat nose	240	15.6



* = Copper jacket



.220 Swift

Index no.	BULLET STYLE	Bullet weight grains	grams
1	Soft point semi pointed	50	3.2
2	Full jacket semi pointed	50	3.2

.222 Rem.

3	Soft point semi pointed	50	3.2
4	Full jacket semi pointed	50	3.2

.243 Win.

5	Hollow point	75	4.9
148	Full jacket semi pointed	100	6.5
151	Soft point semi pointed	100	6.5

.244 Rem.

7	Hollow point	75	4.9
8	Soft point semi pointed	90	5.8

.250 Savage

9	Soft point pointed	87	5.6
10	Soft point pointed	100	6.5

.257 Roberts

11	Soft point pointed	100	6.5
12	Soft point pointed	120	7.8

6,5 Jap.

13	Soft point semi pointed boattail	139	9.0
14	Soft point round nose	156	10.1

6,5x54 MS

15	Soft point semi pointed.	77	5.0
16	Soft point semi pointed boattail	139	9.0
163	Full jacket boattail	139	9.0
17	Soft point round nose	156	10.1
164	Full jacket round nose	156	10.1

6,5x55

105	Soft point semi pointed	77	5.0
19	Full jacket pointed	93	6.0
20	Soft point semi pointed boattail	139	9.0
21	Full jacket boattail	139	9.0
22	Soft point round nose	156	10.1
23	Full jacket round nose	156	10.1

.270 Win.

24	Soft point semi pointed	110	7.1
25	Soft point semi pointed boattail	130	8.4
26	Hollow point boattail	130	8.4
27	Full jacket boattail	130	8.4
28	Soft point semi pointed boattail	150	9.7
161	Full jacket pointed	150	9.7

7x57

Index no.	BULLET STYLE	Bullet weight grains	grams
29	Soft point semi pointed	110	7.1
30	Soft point pointed boattail	150	9.7
31	Full jacket boattail	150	9.7
167	Soft point pointed	154	10.0
32	Soft point round nose	175	11.3

7x61 S&H

33	Soft point pointed boattail	160	10.4

.30 US Carbine (Box of 50)

34	Full jacket round nose	110	7.1
35	Soft point round nose	110	7.1

.30-30 Win.

193	Soft point flat nose	150	9.7
37	Soft point flat nose	170	11.0

.308 Win.

143	Soft point semi pointed boattail	130	8.4
38	Soft point semi pointed boattail	150	9.7
39	Soft point semi pointed boattail	180	11.6

7,62 Russian

214	Soft point pointed boattail	180	11.6

.30-06

40	Soft point semi pointed boattail	130	8.4
42	Full jacket boattail	130	8.4
43	Soft point semi pointed boattail	150	9.7
213	Soft point "Nosler"	150	9.7
45	Soft point semi pointed boattail	180	11.6
46	Hollow point boattail	180	11.6
212	Soft point "Nosler"	180	11.6
48	Soft point round nose	220	14.2
49	Full jacket round nose	220	14.2

.308 Norma Magnum

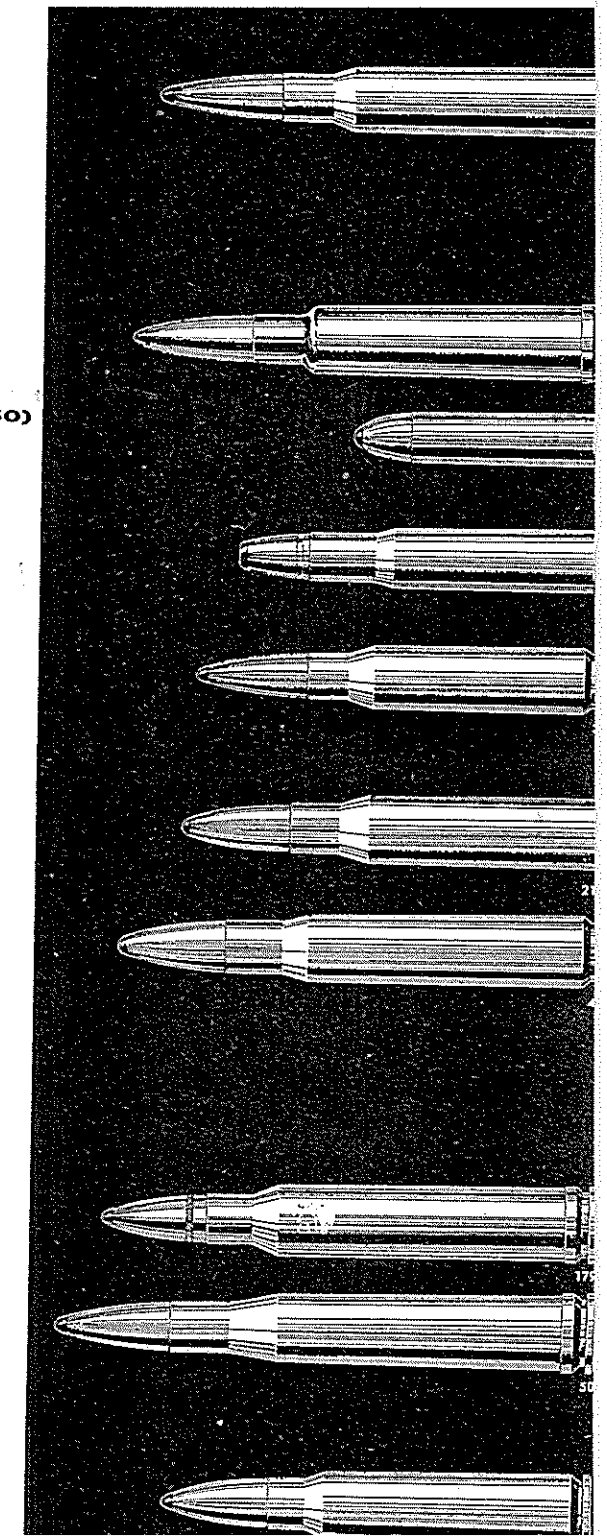
179	Soft point "Dual-core"	180	11.6

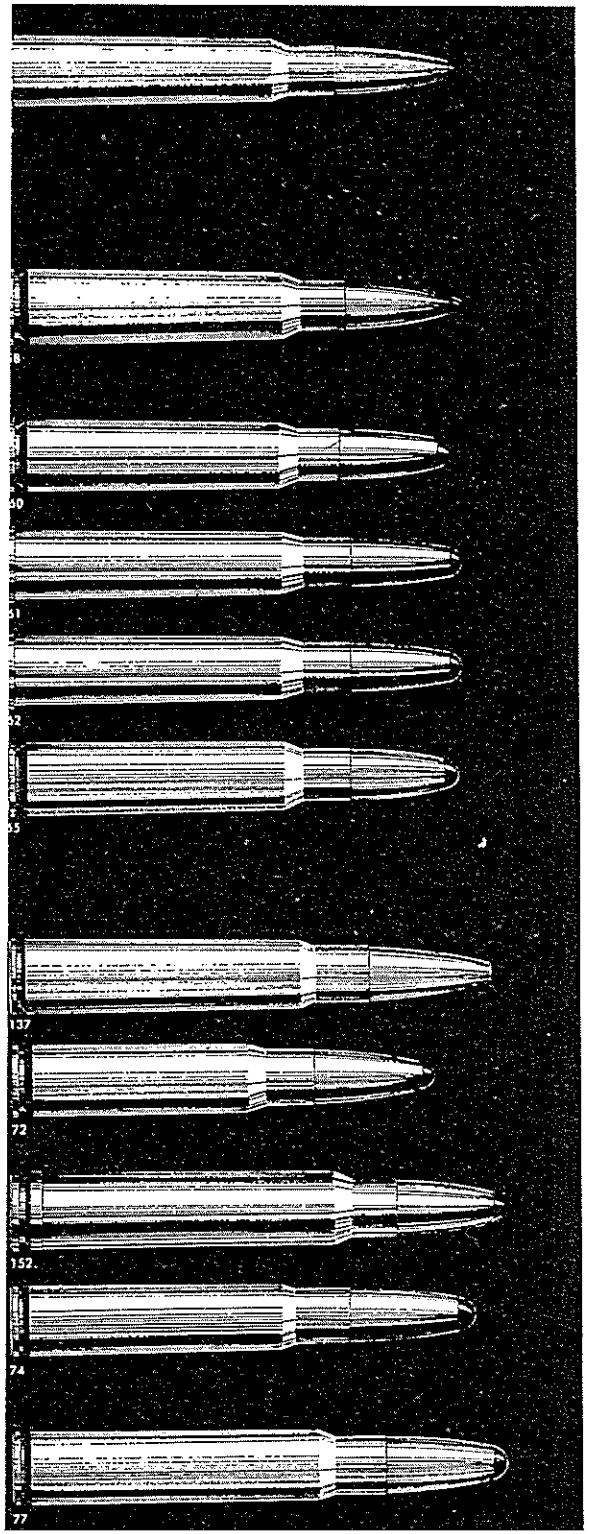
.300 H&H

50	Soft point semi pointed boattail	180	11.6
51	Hollow point boattail	180	11.6
52	Full jacket pointed boattail	180	11.6
53	Soft point round nose	220	14.2
54	Full jacket round nose	220	14.2

7,65 Argentine

187	Soft point semi pointed	150	9.7





.303 British

Index no.	BULLET STYLE	Bullet weight grains	grams
55	Soft point semi pointed	130	8.4
147	Soft point semi pointed	150	9.7
56	Soft point semi pointed boattail	180	11.6
57	Soft point round nose	215	14.0

7,7 Jap.

110	Soft point semi pointed	130	8.4
58	Soft point semi pointed boattail	180	11.6
59	Soft point round nose	215	14.0

8x57 J

60	Soft point round nose	196	12.7

8x57 JR

61	Soft point round nose	196	12.7

8x57 JRS

62	Soft point round nose	196	12.7

8x57 JS

63	Soft point semi pointed	123	8.0
64	Soft point round nose	159	10.3
65	Soft point round nose	196	12.7
67	Hollow point boattail	198	12.8
69	Soft point round nose	227	14.7

8x60 S

137	Hollow point boattail	198	12.8

.358 Win.

71	Soft point semi pointed	200	13.0
72	Soft point semi pointed	250	16.2

.358 Norma Magnum

152	Soft point semi pointed	250	16.2

9,3x57

73	Hollow point boattail	232	15.0
74	Soft point round nose	286	18.5

9,3x62

75	Hollow point boattail	232	15.0
77	Soft point round nose	286	18.5
78	Full jacket round nose	286	18.5

9,3x74 R

Index nr.	BULLET STYLE	Bullet weight grains	grams
80	Hollow point boattail	232	15.0
81	Full jacket pointed	232	15.0
82	Soft point round nose	286	18.5
83	Full jacket round nose	286	18.5

.375 H & H

84	Soft point semi pointed	270	17.5
85	Soft point semi pointed	300	19.4

Norma handgun ammunition

.32 ACP

86	Full jacket round nose	77	5.0

.30 Luger

88	Full jacket round nose	93	6.0

9 mm Luger

91	Full jacket round nose	116	7.5

7,5 Nagant (Berdan primed)

186	Lead round nose	103	6.7

.357 Magnum

174	Hall jacket round nose	158	10.2

.38 SPL

96	Lead wadcutter	148	9.6
97	Lead round nose	158	10.2

.38 S&W[1]

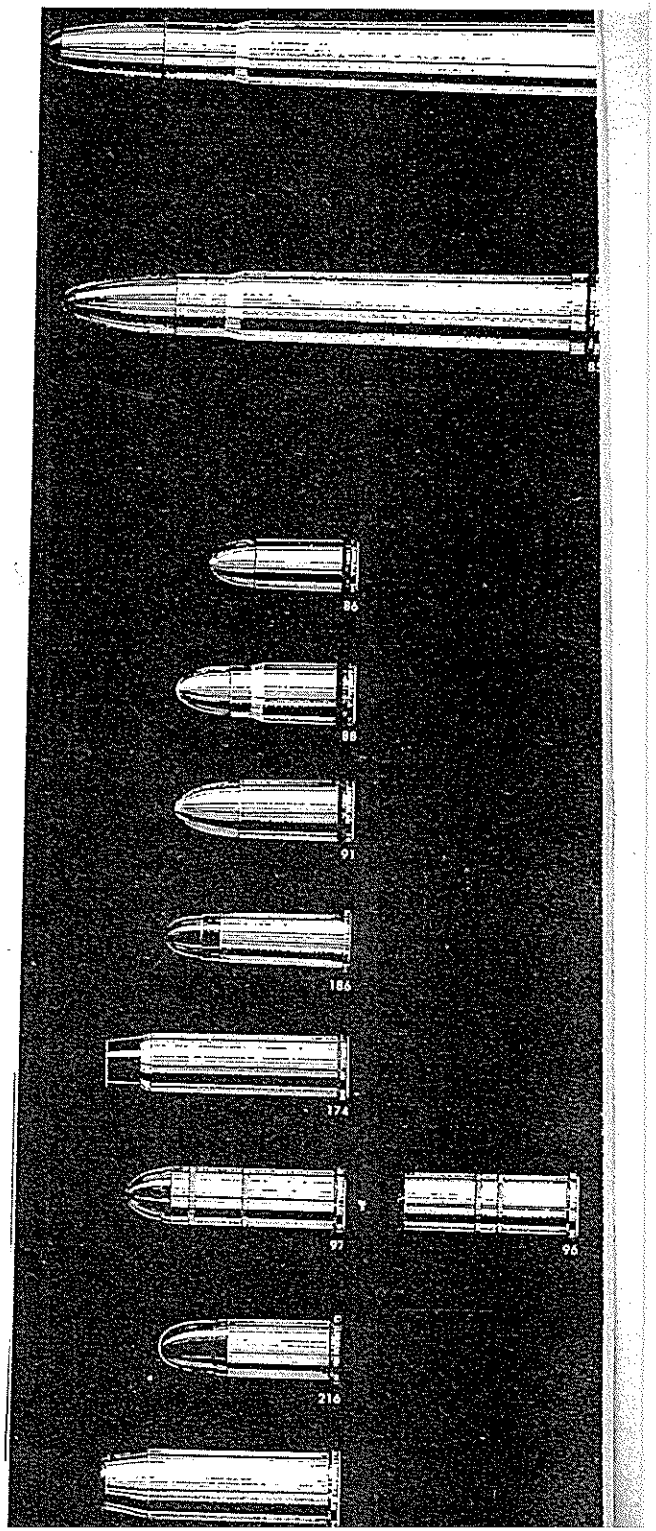
216	Lead round nose	146	9.5

.44 Magnum

175	Soft point flat nose	240	15.6

[1]) Available by fall 1963

[2]) Carbine barrels



APPENDICES

APPENDIX ONE

GROOVE DIAMETER AND TWIST OF RIFLING AMERICAN RIFLES AND HANDGUNS*

Calibre and Cartridge	Make	Min.† Groove	Max. Diameter	Twist of Rifling Turn in inches
.218 Bee	Winchester	.224	.2245	16
.219 Zipper	Winchester	.224	.2245	16
.22 Hornet	Winchester	.222	.2228	16
.22 Hornet	Savage	.223	.224	16
.22 Hornet	Z Brno	.224	.2245	16
.22 Short, R.F.	Winchester	.224		20
.22 Short, R.F.	Stevens	.223	.224	25
.22 Short, R.F., Auto.	Remington	.218	.220	24
.22 Short, R.F., Manually Oper.	Remington	.222	.224	16
.22 Long Rifle, R.F.	Winchester	.222	.2228	16
.22 Long Rifle, R.F.	Stevens	.223	.224	16
.22 Long Rifle, R.F.	Remington	.222	.224	16
.22 W.R.F.	Winchester	.226		14
.22 W.R.F.	Stevens	.223	.224	14
.22 W.M.R.F.	Winchester		.224	16
.220 Swift	Winchester	.224		14
.22/3000 Lovell 2R	Custom	.2235	.224	16
.222 Remington	Remington	.224	.2245	14
.22 Varminter	Gebby	.2235	.224	14
.22-250-3000	Custom	.2235	.2245	14
.22 Savage	Savage	.227	.228	12
6mm Rem.	Remington	.243	.244	9½
.243 Winchester	Winchester	.243		10
.244 Remington	Remington	.243	.244	12
.25 Stevens, R.F.	Stevens	.256	.257	17
.25-20 S.S. & W.C.F.	Winchester	.256	.2575	14
.25-20 S.S. & W.C.F.	Savage	.256	.257	14
.25-20 S.S.	Stevens	.256	.257	13 & 14
.25-35 W.C.F.	Winchester	.256	.2575	8
.25-36 Marlin	Marlin	.257	.2575	9
.25 Remington Auto.	Remington	.256	.258	10
.25 Niedner and .25 Roberts	Niedner	.2565	.2575	10 & 12
.250-3000 Savage	Savage	.257		14
.250-3000 Savage	Winchester	.256	.258	10 & 14
6.5mm Mannlicher Sch.	Steyr	.263	.264	7½
.256 Newton	Newton	.264	.265	10
.257 Roberts	Winchester	.256	.257	10
.257 Remington Roberts	Remington	.256	.258	10
.270 W.C.F.	Winchester	.277	.2785	10
7mm Mauser	German	.2854	.2874	8.66
7mm Mauser	American	.2845	.2855	10
280 Rem.	Remington	.2835	.2845	10
.280 Ross	Ross	.289	.290	8.66
.30-30 W.C.F.	Winchester	.308	.3085	12
.30-30 W.C.F.	Savage	.308	.3085	12
.30 Remington Auto.	Remington	.308	.3085	12
.30-40 Krag Jorgensen	U.S. Govt.	.3075	.311	10
.30-40 Krag	Winchester	.308	.309	10

*We are indebted to the Lyman Gun Sight Corporation for most of this table, but the author has altered it slightly in accordance with his experience.

†Most manufacturers try to adhere to the minimum dimension as standard. Prior to about 1917 many groove diameters slightly exceeded these figures.

Many custom barrels are made intentionally with considerable variations from the above, particularly in twist of rifling.

Calibre and Cartridge	Make	Min.† Groove	Max. Diameter	Twist of Rifling Turn in inches
.308 Winchester	Winchester	.308	.3085	12
.30-06 Springfield	U.S. Govt.	.308	.309	10
.30-06 Springfield	Commercial	.308	.309	10
.30-06 Garand	U.S. Govt.	.308	.309	10
.300 Savage	Savage	.308	.309	12
.300 H & H Magnum	Winchester	.308	.3085	10
8mm Mauser Early	German	.317	.319	9 to 10
8mm Mauser Rimless after 1903	German	.323	.326	9 to 10
.303 Savage	Savage	.308	.309	12
.303 British	English	.312	.314	10
.32 Short & Long R.F.	Winchester	.313	.315	20 to 26
.32 Short & Long R.F.	Stevens	.309	.310	25
.32 Remington Auto.	Remington	.319	.321	14
.32 Ideal	Stevens	.323	.324	18
.32 Winchester-Special	Winchester	.320	.3205	16
.32 Winchester Self-Loading	Winchester	.320	.3205	16
.32-20 W.C.F.	Winchester	.311	.3115	20
.32-20 W.C.F.	Savage	.310	.311	20
.32-40 Ballard & Marlin	Early	.319	.322	16 to 18
.32-40 Recent	Winchester	.320	.3205	16
.33 W.C.F.	Winchester	.338	.3385	12
.348 Winchester	Winchester	.348	.3485	12
.35 Winchester Self-Loading	Winchester	.351	.352	16
.351 Winchester Self-Loading	Winchester	.351	.352	16
.35 Remington Auto.	Remington	.357	.359	16
.35 W.C.F. Model 95	Winchester	.358	.3585	12
.35 Whelen	Griffin	.357	.3575	18
.35 Newton	Newton	.359		12
.358 Winchester	Winchester	.358		12
.375 H & H Magnum	Winchester	.375	.376	12
.38 Short, Long & Extra Long	All	.358	.359	36
.38-40 W.C.F.	Winchester	.400	.4005	36
.38-40 W.C.F.	Remington	.398	.400	36
.38-55 W.B.&M.	Early	.379	.382	18 & 20
.38-55 W.B.&M. Recent	Winchester	.379	.3795	18
.38-56 W.C.F.	Winchester	.379	.3795	20
.38-70-255 W.C.F.	Winchester	.379	.3795	24
.38-72-275 W.C.F.	Winchester	.379	.3795	22
.38-90 W.C.F.	Winchester	.379	.3795	26
.40-50 Sharps Straight	Winchester	.403	.405	18
.40-70 S.S. & Ballard	Winchester	.403	.405	20
.40-70-330 Win. M 1886	Winchester	.408		20
.40-72-330 Win. M 1895	Winchester	.406	.407	22
.40-82-260 Win. M 1886	Winchester	.408		28
.40-90 Sharps Straight	Winchester	.403	.405	18
.40-100 Winchester	Winchester	.403	.405	28
.40-60 Winchester	Winchester	.4045	.405	40
.401 Winchester S.L.	Winchester	.407	.408	14
.404 Jeffry Magnum	Hoffman	.423	.424	14
.405 Winchester	Winchester	.413	.4135	14
.43 Spanish	Winchester	.439	.440	20
.44-40 W.C.F.	Winchester	.4285	.429	36
.44-40 W.C.F.	Remington	.424	.426	20
.44 Henry R.F.	Winchester	.4285	.4295	36
.45-60 W.C.F.	Winchester	.456	.458	20
.45-70 Springfield, U.S.	U.S. Govt.	.457	.459	22
.45-70 Winchester	Winchester	.456	.458	20
.45-75 W.C.F. Model 1876	Winchester	.456	.458	20

Calibre and Cartridge	Make	Min.† Groove	Max. Diameter	Twist of Rifling Turn in inches
.45-90 W.C.F.	Winchester	.458		32
.45-125 W.C.F.	Winchester	.456	.458	36
.45 Sharps, 3¼" Shell	Sharps	.458	.459	18
.50 Sharps	Sharps	.509		
.50-70 Springfield	U.S. Govt.	.515		24 to 42
.50-95 Winchester	Winchester	.5055		60
.50-110-450 Winchester	Winchester	.506		60
.58 Springfield M.L.	U.S. Govt.	.590		68

APPENDIX TWO — TABLE OF GROOVE DIAMETERS OF REVOLVERS

.22 Long Rifle	.222"	9mm Luger	.358"
.22 WMR	.224	.38-40	.401
.25 Automatic	.251	.41 Colt	.401
.30 Mauser	.311	.44-40 Early	.424
.30 Luger	.311	.44-40 Late	.427
.32 Automatic	.312	.44 Russian	.427
.32-20	.312	.44 S & W Special	.427
.38 Special, Colt	.354	.44 Magnum	.427
.38 Special, S & W	.357	.45 Colt Revolver	.452
.357 S & W Magnum	.358	.45 Automatic	.451
.38 Colt Auto.	.356		

APPENDIX THREE — TWIST OF RIFLING IN REVOLVERS AND PISTOLS

Smith & Wesson uses right hand rifling with the following twists.

.22 Revolver	1 turn in 10"
.22 Single Shot	1 turn in 15"
.32-20	1 turn in 12"
.32 S & W	1 turn in 18¾"
.357 & .38 Revolvers	1 turn in 18¾"
.44 Special	1 turn in 20"

The Colt Manufacturing Co makes all revolvers and pistols with left hand twist, 1 turn in 16" except .22 calibre weapons which have 1 turn in 14".

APPENDIX FOUR — HORNADY PROJECTILES

From the Hornady Ballistics Laboratory. Ballistic Coefficients — Sectional Densities

BULLET	Sectional Density	Ballistic Coefficient
22 CALIBRE (.22)		
40 grain jet	.114	.100
22 CALIBRE (.223)		
45 grain Hornet	.128	.218
22 CALIBRE (.224)		
45 grain Hornet	.128	.209
50 grain SX spire point	.143	.223
50 grain spire point	.143	.234
55 grain SX spire point	.157	.246
55 grain spire point	.157	.246
60 grain spire point	.171	.269
6MM CALIBRE (.243)		
70 grain spire point	.169	.244
75 grain spire h.p.	.181	.301
87 grain spire point	.188	.318

100 grain spire point	.216	.368
117 grain round nose	.253	.226
6.5MM CALIBRE (.264)		
100 grain spire point	.206	.287
129 grain round nose	.266	.272
140 grain spire point	.288	.483
140 grain round nose	.288	.287
160 grain round nose	.330	.236
270 CALIBRE (.277)		
100 grain spire point*	.186	.258
130 grain spire point	.242	.443
150 grain spire point	.279	.491
150 grain round nose	.279	.259
25 CALIBRE (.257)		
60 grain spire point*	.130	.165
75 grain spire h.p.	.162	.255
87 grain spire point	.188	.318
100 grain spire point	.216	.368
117 grain round nose	.253	.226
7MM CALIBRE (.284)		
120 grain spire point	.212	.353
139 grain spire point	.246	.400
154 grain spire point	.273	.433
154 grain round nose	.273	.210
175 grain round nose	.310	.271

*Regular spire point. All other spire points in secant Ogive design.

All coefficients are according to Ingalls, and all were obtained through actual test firing in our laboratory and have been corrected to see level.

APPENDIX FIVE — SPEER JACKETED BULLETS

All bullets are expanding.

Calibre & Grains	Shape	Number	Sectional Density	Ballistic Coefficient*
.224" 40	Spire	.224—40—OS—SP	.114	.143
.224" 45	Spitzer	.224—45—4—SP	.128	.160
.224" 50	Spitzer	.224—50—6—SP	.142	.167
.224" 52	Hollow Pt.	.224—52—6—HP	.147	.195
.224" 55	Spitzer	.224—55—6—SP	.157	.209
.243" 75	Hollow Pt.	.243—75—8—HP	.181	.267
.243" 90	Spitzer	.243—90—8—SP	.217	.323
.243" 105	Round	.243—105—GP—SP	.254	.256
.243" 105	Spitzer	.243—105—10—SP	.254	.395
.257" 60	Spire	.257—60—OS—SP	.129	.161
.257" 87	Spitzer	.257—87—5—SP	.188	.294
.257" 100	Spitzer	.257—100—6—SP	.216	.354
.257" 120	Spitzer	.257—120—6—SP	.258	.425
.263" 87	Spitzer	.263—87—5—SP	.179	.280
.263" 120	Spitzer	.263—120—6—SP	.247	.405
.263" 140	Spitzer	.263—140—6—SP	.289	.482
.277" 100	Spitzer	.277—100—6—SP	.186	.283
.277" 130	Spitzer	.277—130—6—SP	.241	.395
.277" 150	Spitzer	.277—150—6—SP	.278	.463
.284" 130	Spitzer	.284—130—6—SP	.230	.365
.284" 145	Spitzer	.284—145—6—SP	.257	.425
.284" 160	Spitzer	.284—160—6—SP	.284	.469
.3085" 110	Spire	.3085—110—OS—SP	.166	.261
.3085" 130	Hollow Pt.	.3085—130—6—HP	.195	.281
.3085" 150	Flat Pt.	.3085—150—WR—SP	.225	.244

.3085" 150	Semi Pt.	.3085—150—GP—SP	.225	.218
.3085" 150	Spitzer	.3085—150—6—SP	.225	.387
.3085" 180	Round	.3085—180—GP—SP	.270	.288
.3085" 180	Spitzer	.3085—180—6—SP	.270	.435
.3085" 200	Semi Pt.	.3085—200—GP—SP	.301	.425
.3085" 200	Spitzer	.3085—200—6—SP	.301	.502
.311" 150	Spitzer	.311—150—6—SP	.221	.365
.311" 180	Semi Pt.	.311—180—GP—SP	.265	.282
.321" 170	Flat	.321—170—WR—SP	.236	.242
.323" 125	Spire	.323—125—OS—SP	.171	.225
.323" 150	Spitzer	.323—150—6—SP	.205	.298
.323" 170	Semi Pt.	.323—170—SS—SP	.232	.331
.323" 225	Round	.323—225—GP—SP	.309	.395
.333" 275	Semi Pt.	.333—275—SS—SP	.354	.499
.349" 180	Flat	.349—180—W—SP	.211	.222
.349" 220	Flat	.349—220—W—SP	.258	.272
.3585" 180	Round	.3585—180—R—SP	.201	.223
.3585" 220	Round	.3585—220—R—SP	.246	.267
.3585" 250	Spitzer	.3585—250—6—SP	.279	.423
.3755" 235	Semi Pt.	.3755—235—SS—SP	.239	.257
.3755" 285	Semi Pt.	.3755—285—SS—SP	.289	.375
.3755" 285	Rd. FMJ	.3755—285—SS—FMJ	.289	.375

*Ballistic Coefficient, particularly for use with Speer Ballistics Calculator to determine bullet drop, mid-range trajectory, remaining velocity, and bullet energy.

APPENDIX SIX — SIERRA JACKETED BULLETS

.22 CALIBRE (.223")
- 40 grain Hornet
- 45 grain Hornet

.22 CALIBRE (.224")
- 40 grain Hornet
- 45 grain Hornet
- 45 grain Semi-Pointed
- 45 grain Spitzer
- 50 grain Semi-Pointed
- 50 grain Spitzer
- 55 grain Semi-Pointed
- 55 grain Spitzer
- 63 grain Semi-pointed

6MM (.243")
- 60 grain Hollow Point
- 75 grain Spitzer H.P.
- 85 grain Spitzer
- 100 grain Spitzer
- 100 grain Semi-Pointed

.22 CALIBRE (.257")
- 75 grain Hollow Point
- 87 grain Spitzer
- 110 grain Spitzer
- 117 grain Spitzer F.B.
- 117 grain Spitzer B.T.

6.5MM (.264")
- 120 grain Spitzer
- 140 grain Spitzer B.T.

.270 CALIBRE (.277")
- 110 grain Spitzer
- 130 grain Spitzer F.B.
- 130 grain Spitzer B.T.
- 150 grain Spitzer B.T.

7MM (.284")
- 120 grain Spitzer
- 140 grain Spitzer
- 160 grain Spitzer B.T.

.30 CALIBRE (.308")
- 125 grain Spitzer
- 150 grain Spitzer
- 180 grain Spitzer F.B.
- 180 grain Spitzer B.T.
- 180 grain Matchking*

.303 CALIBRE (.311")
- 150 grain Spitzer
- 180 grain Spitzer

8MM (.323")
- 150 grain Spitzer
- 175 grain Spitzer

GAS CHECKS
- .22, .25, .270, .30, .32, and 8MM Calibre

*180-grain Matchking, full jacket, Spitzer, boattail bullet is now the preferred bullet for long-range, 1000-yard match shooting, in 1-10 twist barrels.

APPENDIX SEVEN — RELOADING SCHEDULE

All these are heavy loadings and must be worked up to. M stands for maximum in SMLE rifles.

Primer	Bullet Dia.	Bullet Wt. grains	Powder	Weight in grains	Velocity FS
.22 Hornet					
S.R.	.223	45 — 48 L	Ballistite	3.5	1400
		48 G.C.	Ballistite	4.5	1600
		48 G.C.	Nobel's Hornet	9.5	2400
		45 — 46 J	Nobel's Hornet	10.5	2650
		50 J	Nobel's Hornet	10.0	2500
.218 Bee					
S.R.	.224	48 G.C.	Ballistite	5.5	1800
		45 — 46 J	Nobel's Hornet	12.0	2850
		45 — 46 J	2202	13.0	3000
		50 J	Nobel's Hornet	11.0	2650
		50 J	Norma 200	15.0	2750
.222 Remington					
S.R.	.224	48 G.C.	2202	11.0	2300
		45 J	4740	23.0	3350
		50 J	4740	22.5	3300
		55 J	4740	21.0	3100
	Factory	50 J	200	21.0	3200
.222 Remington Magnum					
S.R.	.224				
		48 G.C.	2202	11.5	2300
		40 J	4740	28.0	3750
		45 J	4740	27.0	3550
		50 J	4740	26.0	3400
		55 J	4740	24.5	3200
.22/.303 SMLE Action					
L.R.	.224	48 G.C.	2202	12.0	2000
		45 J	4740	34.0	3600
		46 J	203	36.0	3700—M
		50 J	4740	32.0	3300—M
		45 J	4740	32.0	3400
		50 J	4740	30.0	3200
		55 J	4740	28.0	3000
.219 Zipper					
L.R.	.224	48 G.C.	Ballistite	7.0	1500
		45/46 J	4740	28.0	3500
		50 J	4740	27.0	3200
		55/56 J	4740	26.0	3000
.220 Swift (X) (.220/.303 on P14 or Mauser type action)					
L.R.	.224				
	Factory	50 J	203	41.0	4110
		48 G.C.	Ballistite	10.0	2400
		48 J	4740	37.0	3850
		55 J	4740	35.0	3500
		63 J	4740	34.0	3300
.22 Savage Hi-Power					
L.R.	.226	60 G.C.	2202	12.0	1900
		68/70 J	4740	26.0	2700

Primer	Bullet Dia.	Bullet Wt. grains	Powder	Weight in grains	Velocity FS
.22 Sprinter					
L.R.	.224	48 G.C.	2202	11.0	2000
		45 J	4740	32.0	3500
		50 J	4740	30.0	3300
.22 Wasp (.22/.303 Wasp)					
L.R.	.224	48 G.C.	Nobel's Hornet	11.0	2000
		48 G.C.	Ballistite	7.0	1600
		45 J	4740	28.0	3500
		50 J	4740	26.5	3400
		55 J	4740	27.0	3300
		55 J	41	29.0	3500
.243 Winchester					
L.R.	.243	70 J	4740	38.5	3450
		75 J	4740	37.5	3400
		75 J	41	41.5	3400
		80 J	4740	36.0	3300
		80 J	41	40.5	3300
		87/90 J	4740	35.0	3300
		90 J	41	36.0	3300
		100 J	4740	33.5	2900
	Factory	75 J	203	42.1	3500
		100J	204	43.2	3070
.244 Remington (6 mm Rem)					
L.R.	.243	75 J	4831	52.0	3530
		75 J	4740	38.0	3450
		80 J	4831	51.0	3400
		80 J	4740	37.0	3350
		90 J	4831	50.0	3350
		90 J	4740	35.0	3100
	Factory	75 J	203	42.3	3500
		90 J	204	44.2	3200
6 mm Remington — All the foregoing loads may be used.					
		100 J	4831	45.0	3100
		100 J	104	44.0	3150
		105 J	4831	44.0	2950
.25/.20 W.C.F.					
S.R.	.257	86 L	Ballistite	4.5	1300
		86 G.C.	2202	9.0	1550
		60 J	Nobel's Hornet	12.0	2200
		70 J	Nobel's Hornet	11.0	2000
		86 J	Nobel's Hornet	10.0	1750
.250 Savage					
L.R.	.257	80 G.C.	2202	16.0	2000
		70 J	4740	37.0	3300
		87 J	4740	35.0	3000
		87 J	41	37.0	3000
		100 J	4740	32.0	2750
		100 J	4895	37.0	2900
		100 J	4831	44.0	2900
	Factory	87 J	203	35.4	3032
		100 J	203	35.4	2822
.257 Rem. Roberts					
L.R.	.257	86 G.C.	2202	16.0	2000
		86 G.C.	4740	25.0	2000
		100 G.C.	200	20.0	1900

Primer	Bullet Dia.	Bullet Wt. grains	Powder	Weight in grains	Velocity FS
		100 G.C.	Ballistite	11.0	1600
		87 J	4740	43.5	3250
		87 J	4895	44.0	3350
		100 J	4740	38.0	3000
		100 J	4831	49.0	3200
		100 J	4895	40.0	3100
		120 J	4831	45.0	2850
		125 J	4831	44.0	2750
	Factory	100 J	203	38.0	2900
		120 J	203	36.6	2645
		87 J	41	41.0	3000
.250/.303 SMLE					
L.R.	.257	87 J	4740	30.0	2850
		100 J	4740	28.0	2600
		86 G.C.	Nobel's Hornet	14.0	1800
6.5/54 MS (Factory)					
L.R.	.264	77 J	203	40.5	3117
		139 J	203	37.8	2580
		156 J	203	37.4	2461
6.5/55 (Factory)					
L.R.	.264	77 J	200	37.8	3120
		93 J	203	45.2	3150
		139 J	204	46.6	2789
		156 J	204	44.2	2493
.264 Winchester Magnum					
L.R.	.263 / .264	87 J	4831	73.0	3500
		87 J	203	57.0	3700
		87 J	4740	52.0	3600
		100 J	4831	70.0	3500
		100 J	4740	50.0	3250
		100 J	204	64.0	3400
		120 J	4831	67.0	3250
		120 J	4740	48.0	3000
		120 J	204	61.0	3300
		140 J	4831	64.0	3000
		160 J	4831	62.0	2850
.270/.303 SMLE					
L.R.	.277	100 J	Cordite (Service		2850
		100 J	4740 charge)	36.0	2750
		130 J	4740	32.0	2400
.270 Winchester					
L.R.	.277	100 G.C.	4740	28.0	2200
		100 J	4740	48.0	3400
		100 J	4831	63.0	3400
		130 J	4740	44.0	3000
		130 J	4831	60.0	3150
		150 J	4831	57.0	2900
		170 J	4831	55.0	2800
	Factory	110 J	203	52.0	3248
	"	130 J	204	57.0	3140
		150 J	204	52.5	2802

Primer	Bullet Dia.	Bullet Wt. grains	Powder	Weight in grains	Velocity FS
.284 Winchester		130J	204	56.0	3100
L.R.	.283/.284	154J	204	54.0	2900
		160J	204	53.0	2800
.280 Remington					
L.R.	.283/.284	110 J	4740	47.0	3150
		130 J	4740	46.0	3000
		130 J	4831	60.0	3150
		145 J	4831	58.0	2950
		160 J	4831	57.0	2700
		100 J	4740	48.0	3100
		125 J	4740	46.0	3000
	Note: Heavier loadings may be used in bolt actions.				
7 mm Remington Magnum or Weatherby					
L.R.	.283/.284	130 J	4831	76.0	3450
		130 J	4740	56.0	3300
		145 J	4831	73.0	3350
		145 J	4831	54.0	3100
		160 J	4831	70.0	3100
		175 J	4831	67.0	2900
7 x 57 Mauser					
L.R.	.283/.284	130 J	4831	55.0	2950
		130 J	4740	42.0	2900
	Factory	101 J	203	45.8	3068
	"	150 J	203	44.1	2756
	"	175 J	203	42.3	2490
7 x 61 Sharpe & Harte					
L.R.	.283/.284	145 J	4831	68.0	3220
		160 J	4831	67.0	3090
		130 J	4831	70.0	3350
		120 J	4740	45.0	3000
	Factory	160 J	204	60.0	3100
	"	110 J	204	64.0	3395
	"	175 J	204	61.3	2900
.30-06 Springfield					
L.R.	.308	80 (32-20W C.F.) J	Ballistite	20.0	2600
		110 J	4740	52.0	3000
		150 J	4740	46.0	2700
		180 J	4740	44.0	2500
	Factory	130 J	203	57.5	3280
	"	150 J	203	54.7	2970
	"	180 J	203	50.0	2700
	"	220 J	203	47.3	2400
.308 Winchester					
L.R.	.308	110 J	4740	47.0	3150
		110 J	4895	52.0	3150
		150 J	4740	43.0	2850
	Factory	130 J	200	40.5	2900
	"	180 J	203	44.3	2610
.303 SMLE Action					
L.R.	.312	125 J	4740	43.5	2750
		150 J	4740-	41.0	2500
	Factory	130 J	200	39.5	2789
	"	150 J	201	44.5	2720
	"	180 J	203	43.5	2540
7.7	"	215 J	203	39.5	2185

7.7 x 54 SMLE Action — Reduce loads by 2 grains.

Primer	Bullet Dia.	Bullet Wt. grains	Powder	Weight in grains	Velocity FS
.308 Norma Magnum					
L.R.	.308 Factory	180 J	204	72.5	3100
		110 J	203	72.5	3724
		130 J	204	77.8	3504
		150 J	204	76.8	3317
		180 J	204	73.5	3173
		220 J	204	68.0	2760
.310 Cadet					
S.R.	.323	120 L	Cadet Neonite	6.0	1200
32-20 Winchester					
S.R.	.311	80 G.C.	Nobel's Hornet	10.0	1500
		100 G.C.	2202	12.0	1800
		80 J	Nobel's Hornet	14.5	2000
		115 J	Nobel's Hornet	12.0	1700
38-40 Winchester					
L.R.	.401	130 J	2202	24.0	1900
		180 J	Nobel's Hornet	19.0	1850
	Factory (1873)	175 G.C.	Nobel's Hornet	15.0	1300
44-40 Winchester					
L.R.	.427	140 J	Nobel's Hornet	30.0	2400
		200 J	Nobel's Hornet	26.0	2000
	Factory (1873)	200 L	Nobel's Hornet	16.0	1300
.357 Magnum (revolver-carbine)					
S.R.	.357	158 J	R23	13.2	1675
44 Magnum Carbine (revolver-carbine)					
L.R.	.429	240 J	R23	20.5	1675

APPENDIX EIGHT — SPECIAL CARTRIDGES

.25-20 Special					
S.R.	.256	60 J	Nobel's Hornet	15.0	2800
		70 J	Nobel's Hornet	14.5	2600
		86 G.C.	Nobel's Hornet	12.0	2000
		86 J	2202	13.0	2200
.218 Improved Bee					
S.R.	.224	45 J	2400	14.5	3200
		50 J	Nobel's Hornet	14.0	2950
		50 J	2202	15.0	3000
K-Hornet					
S.R.	.223-.224	45 J	Nobel's Hornet	12.5	3000
		50 J	2202	11.5	2600

NOTE: J = Jacketed projectile, L = Lead, cast one part tin to 15 lead, G.C. = gas-check on the lead bullet given for velocities under 2000 F.S. and one part tin to ten parts of lead above 2000 F.S.

All the above loadings are regarded in all ways as quite safe for well-constructed arms in good condition. It is pointed out that they should be worked up to, using a powder scale, as a combination of a tight bore, a thick case, a fractionally-over-sized bullet, together with a hotter-than-usual primer, can well bump pressures as high as 15,000 to 20,000 lb psi above normal.

APPENDIX NINE — BALLISTICS OF POPULAR CARTRIDGES

Cartridge	Bullet Grains	Velocity fs Muzzle	100 yds	200 yds	300 yds	Energy ft/lb 100 yds	200 yds	300 yds	Inches Mid-range Trajectory 100 yds	200 yds	300 yds
.22 Hornet	46	2690	2030	1510	1150	420	235	135	0.8	4.3	13.0
.218 Bee	46	2860	2160	1610	1200	475	265	145	0.7	3.8	11.5
.219 Zipper	56	3110	2440	1940	1550	740	465	300	0.6	2.9	8.3
.222 Rem	50	3200	2660	2170	1750	785	520	340	0.5	2.5	7.0
.222 Magnum	55	3300	2800	2340	1930	955	670	455	0.5	2.3	6.1
.220 Swift	48	4110	3490	2930	2440	1300	915	635	0.3	1.4	3.8
.22 Savage	70	2780	2480	2200	1940	955	755	585	0.6	3.0	7.0
.240 Flanged	100	2800	2570	2355	2140	1470	1230	1020	0.6	2.6	5.9
.240 Belted	100	2900	2665	2445	2235	1580	1330	1110	0.6	2.4	5.8
.242 Rimless	100	3000	2740	2490	2260	1635	1355	1120	0.5	2.3	5.7
.243 Win	80	3500	3080	2720	2410	1690	1320	1030	0.4	1.8	4.7
	100	3070	2790	2540	2320	1729	1430	1195	0.5	2.2	5.5
6 mm Rem	100	3190	2920	2660	2420	1890	1570	1300	0.5	2.0	5.0
.25-20	86	1460	1180	1070	940	265	200	170	2.6	12.5	32.0
	60	2250	1660	1240	1030	365	205	140	1.2	6.3	21.0
.25-35 Win	117	2300	1910	1600	1340	945	665	465	1.0	4.6	12.5
.250 Savage	87	3030	2660	2330	2060	1370	1050	820	0.6	2.5	6.4
	100	2820	2460	2140	1870	1340	1020	775	0.6	2.9	7.4
.257 Roberts	87	3200	2840	2500	2190	1560	1210	925	0.5	2.2	5.7
	100	2900	2540	2210	1920	1430	1080	820	0.6	2.7	7.0
	117	2650	2280	1950	1690	1350	985	740	0.7	3.4	8.8
6.5 x 54 MS	77	3117	2731	2369	2036	1274	960	710	0.0	1.9	5.6
	139	2580	2420	2270	2120	1808	1591	1388	0.2	2.4	6.5
	155	2461	2240	2033	1840	1738	1422	1173	0.3	3.0	8.2
6.5 x 55	77	3120	2720	2370	2040	1275	961	712	0.0	1.9	5.6
	93	3150	2705	2292	1920	1512	1085	762	0.0	1.9	6.0
	139	2789	2630	2470	2320	2136	1883	1662	0.1	2.0	5.6
	156	2493	2271	2062	1867	1787	1473	1208	0.3	2.9	7.9
7 x 57 mm Mauser	110	3068	2792	2528	2277	1904	1561	1267	0.0	1.6	5.0
	150	2756	2539	2331	2133	2148	1810	1516	0.1	2.2	6.2
	175	2490	2170	1900	1680	1830	1403	1097	0.4	3.3	9.0
.30 US carb	110	1970	1575	1300	1090	622	413	290	0.8	6.4	19.0
.30-30 Win	170	2220	1890	1630	1410	1349	1003	750	0.7	4.1	11.9
.300 Sav	150	2670	2390	2130	1890	1900	1510	1190	0.7	3.0	7.6
	180	2370	2160	1960	1770	1860	1530	1250	0.9	3.7	9.2
.32-20 Win	80	2100	1430	1090	950	365	210	160	1.5	8.5	24.5
	100	1290	1060	940	840	250	195	155	3.3	15.5	38.0
.358 Win	200	2530	2210	1910	1640	2160	1610	1190	0.8	3.6	9.4
	250	2250	2010	1780	1570	2230	1760	1370	1.0	4.4	11.0
.44-40 Win	200	1310	1050	940	830	490	390	305	3.3	15.0	36.5
MILITARY GROUP											
.308 Win	130	2900	1590	2200	2030	1937	1527	1190	0.1	2.1	6.2
	150	2860	2570	2300	2050	2200	1762	1400	0.1	2.0	5.9
	180	2610	2400	2210	2020	2303	1952	1621	0.2	2.5	6.6
.303 British	130	2789	2483	2195	1929	1780	1391	1075	0.1	2.2	6.7
	150	2720	2440	2170	1920	1983	1569	1241	0.1	2.2	6.5
	180	2540	2340	2147	1965	2189	1843	1544	0.2	2.7	7.3
	215	2182	1947	1733	1541	1810	1434	1134	0.5	4.1	11.2
.30 Springfield	130	3281	2951	2636	2338	2514	2006	1578	0.1	1.5	4.6
	150	2972	2680	2402	2141	2393	1922	1527	0.0	1.9	7.5
	180	2700	2530	2365	2206	2559	2236	1946	0.1	2.2	6.1
	220	2411	2197	1996	1809	2358	1947	1599	0.3	3.1	8.5
7.7 mm Jap	130	2950	2635	2340	2065	2004	1581	1231	0.1	2.0	5.9
	180	2493	2292	2101	1922	2100	1765	1477	0.2	2.8	7.7
	215	2264	2023	1802	1602	1954	1550	1227	0.5	3.8	10.4
8 x 57 J	159	2723	2262	2030	1734	1970	1455	1062	0.2	2.6	7.9
	196	2526	2195	1894	1637	2097	1562	1152	0.3	3.1	9.1

(Table continues overleaf)

BALLISTICS OF POPULAR CARTRIDGES

(Continued)

Cartridge	Bullet Grains	Bullet Muzzle	Velocity fs 100 yds	Velocity fs 200 yds	Velocity fs 300 yds	Energy ft/lb 100 yds	Energy ft/lb 200 yds	Energy ft/lb 300 yds	Inches mid-range trajectory 100 yds	Inches mid-range trajectory 200 yds	Inches mid-range trajectory 300 yds
LONG RANGE AND MAGNUM CARTRIDGES											
.270 Win	100	3580	3160	2770	2400	2210	1700	1280	0.4	1.7	4.5
	130	3140	2850	2580	2330	2340	1920	1550	0.5	2.1	5.3
	150	2800	2400	2040	1750	1920	1380	1020	0.7	3.0	7.8
.280 Rem	100	3570	3160	2770	2420	2220	1700	1300	0.4	1.7	4.5
	125	3190	2880	2590	2320	2300	1860	1490	0.5	2.1	5.3
	150	2900	2670	2450	2220	2370	2000	1640	0.6	2.5	6.1
	165	2820	2510	2230	1970	2310	1810	1420	0.6	2.8	7.2
.284 Win	125	3200	2880	2590	2310	2300	1860	1480	0.5	2.1	5.3
	150	2900	2620	2380	2160	2290	1890	1550	0.6	2.7	6.3
.264 Win Mag	100	3700	3260	2880	2550	2360	1840	1440	0.4	1.6	4.2
	140	3200	2940	2700	2480	2690	2270	1910	0.5	2.1	4.9
7 x 61 S & H	110	3410	3110	2825	2550	2363	1950	1590	0.1	1.1	3.8
	160	3100	2927	2757	2595	3045	2701	2393	0.0	1.5	4.3
	175	2900	2560	2275	2040	2547	2012	1618	0.1	2.1	6.2
7 mm Rem Mag	150	3260	2950	2670	2430	2900	2380	1870	0.2	1.7	5.0
	175	3020	2670	2360	2100	2770	2160	1710	0.4	1.9	6.0
.300 Win Mag	150	3400	3050	2730	2430	3100	2480	1970	0.1	1.3	4.0
	180	3070	2810	2570	2320	3200	2680	2200	0.1	1.7	5.3
.300 H & H	150	3190	2870	2580	2300	2740	2220	1760	0.4	2.1	5.2
	180	2920	2706	2500	2297	2927	2499	2109	0.5	1.9	5.3
	220	2625	2400	2170	1986	2814	2301	1927	0.6	2.5	7.0
.308 Norma Mag	180	3100	2881	2668	2464	3318	2846	2427	0.0	1.6	4.6

Note: In some cartridges like the 240 Flanged, 240 Belted and others, full figures are not yet to hand. Here we have included factory calculations. Different factories use different tables for calculating remaining velocity and mid-height trajectory figures, so variations occur which are purely the result of different techniques. They are not conclusive evidence that one cartridge is superior to another.

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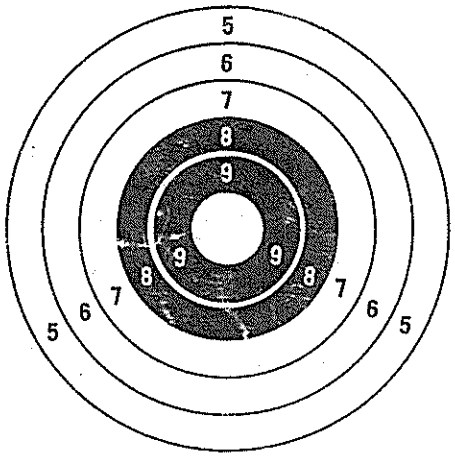

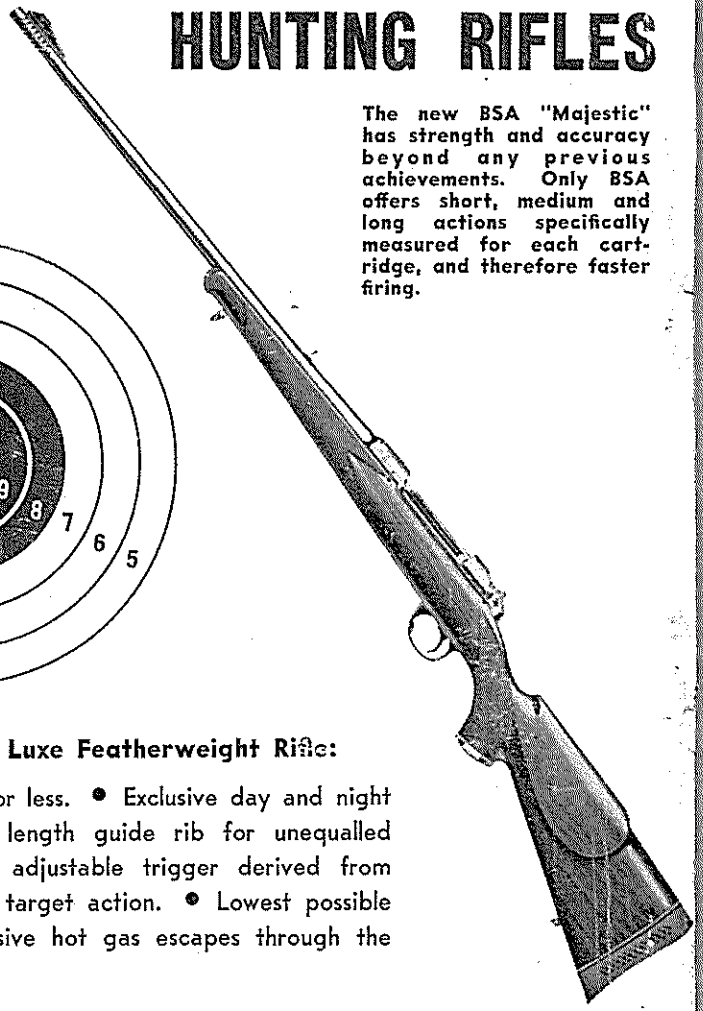

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