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FIREARMS - TOOLMARKS EXAMINATIONS

FIREARMS EXAMINATIONS

I. INTRODUCTION:

A. Definitions:

1. Firearms Examinations: encompasses the study of Firearms Identification; Bullet Path Analysis; Shot Patterns & Gunshot Residue Analysis; Crime Scene Investigation; Firearms Design; Function firing; and Ammunition Testing.

2. Firearms Identification: is primarily the study of microscopic marks appearing on the surfaces of bullets, cartridge & shotshell cases. It's primary purpose is to identify these ammunition components as having been fired in/or functioned through a specific firearm to the exclusion of all other firearms.

3. Ballistics: Is the study of projectiles in motion;

It is subdivided into;

a. Interior Ballistics; The study of projectiles while within the confines of the firearm.

b. Exterior Ballistics; The study of projectiles after it leaves the firearms and during its flight to target.

c. Terminal Ballistics; The study and effect of the projectile on the target.

4. Calibre: In general, calibre, denotes the nominal bore diameter of a barrel measured in either hundredths of an inch (.01) or in millimeters (mm). This provides an initial grouping capability, such as referring to .22 calibre, 30 calibre , or 38 calibre, etc.

However, within each group or calibre family there may be numerous cartridges, and in many instances not interchangeable.

Of more importance it is to establish the specific cartridge designation. These designations expand from the basic calibre grouping in a variety of ways. Among them are the following:

a. Descriptive Words: 38 Special; 41 Magnum; 9mm Bayard.
b. Original powder charge: 25-20
c. Manufacturer's or Designer's name:
   (1) 30 Remington - 6mm Remington
   (2) 38 Colt
d. Velocity: 250-3000
e. Year of adoption: 30-06
f. Bore Diameter & Case Length:
   (1) 8 x 57mm
   (2) 7.63 x 39mm

Both rimfire and centerfire ammunition (cartridges) normally have manufacturer's markings stamped into the head of the cartridge for identification. These markings are known as the "Headstamp".

These Markings may contain the manufacturer's name, initials, trade name and/or symbols, and cartridge designation.

B. Basis of Science: It is humanly impossible for man to create any two items exactly alike and this premise is verified to us through the microscope.

These microscopic marks are individual and characteristics of a specific firearms and result from:

1. Tools used in the manufacturing processes which produce the firearms and it's many component parts.

2. Subsequent use/abuse of that particular firearm by its owners.

These marks are transferred to the softer metal of the ammunition during the loading, firing, extracting and ejecting cycles.

Microscopic study and comparison will then permit the following conclusions.

C. Conclusions:

1. The ammunition component **was fired** from/in the firearm in question.

2. The ammunition component **was not fired** from/in the firearm in question.

3. There are **not sufficient** microscopic marks to determine if it was or was not fired in/from the firearm in question.

When an identification is effected it is as positive as a fingerprint identification.

II. AMMUNITION: Cartridges and Shotshells

A. Cartridges: Divided into two major categories;

1. Rimfire - Priming material is contained around the rim of the cartridge head. Large numbers produced but primarily available in Calibre .22.

2. Centerfire - Priming material located in self-contained primer cup positioned in center of the head of a cartridge, as in 9mm Luger.

B. Cartridge Components:

1. Bullet:
   a. Composition: Lead, plated lead, jacketed and steel.
   b. Design: The design or shape of a bullet is determined by numerous factors, such as velocity, use for which it is intended, ballistics, & type of firearm in which it is to be fired.
   c. Cannelures: Grooves or rings around bullets used for;
      (1) Crimping
      (2) Lubrication
      (3) Identification of manufacturer
      (4) Identification of bullet weight or design

2. Shot Pellets

   a. Composition: Lead, Plated lead, and Steel.
      Pellets are not identifiable with a specific firearm.

3. Cartridge Case: The container holding components together and subdivided into the following types:

   a. Rimmed: Having a rim around the head of a cartridge case & larger than it's body diameter; as in revolver cartridges.
   b. Rimless: Having a rim around the head of a cartridge case the same diameter as the case body; as in Calibre .45 ACP.

c. Semi-rimmed: Having a rim around the head of a cartridge case and slightly larger than the case body; as in Calibre .25 ACP.

d. Belted: Having a band or reinforcement to the cartridge case at it's base; as in Calibre 300 Winchester Magnum.

Cartridge cases may be straight, tapered, or bottle necked.
Cartridge cases may be made of brass, steel or as in shotshells a combination of plastic, brass and/or steel.

4. Powder or Propellant: Can be;

a. Black Powder (little used today in modern cartridge ammunition) Made from ;
(1) Charcoal 15%
(2) Sulfur 10%
(3) Potassium nitrate 75%

b. Smokeless (most commonly encountered today in modern cartridge ammunition) Two types;

(1) Single base: Nitrocellulose partially dissolved in solvent and then evaporated into a glue like mass or colloid.
(2) Double base: A colloid solution of nitrocellulose and nitroglycerin.

5. Primer mixture; is a compound but contains some or all of the following: antimony, barium, lead, mercury and/or potassium.

6. Primer cup (excluded in rim fire cartridges); is a small metal cup that contains the primer mixture and receives the blow from the firing pin.

C. Shotshells: (shotgun ammunition)

1. The complete round consists of the following components:

a. Shotshell case - cardboard or plastic cylinder with metal head
b. Shot pellets (bird shot), buckshot, rifled slugs, or sabots.

c. Powder charge
d. Wads
   (1) Composition - cardboard - plastic - felt - cork
   (2) Single units or multi layered
e. Primer cup
f. Primer mixture
g. Battery Cup

III. THE GUN:

A. Revolver - A handgun with a cylinder having several chambers so arranged as to rotate around and axis and be discharged successively by the same firing mechanism. Has a rifled barrel.

B. Pistols (frequently called "automatics" but technically semi-automatic or self-loading). Has a rifled barrel.

C. Derringer - a small handgun of single shot or multi-barrel design. Has a rifled barrel

D. Rifles - A firearm having rifling in the bore and designed to be fired from the shoulder.

1. Automatic (technically semi-automatic or auto-loading)
2. Pump action
3. Bolt action
4. Lever action
5. Single shot or break open

E. Shotguns

1. Automatic (technically semi-automatic or auto-loading)
2. Pump action
3. Bolt action
4. Lever action
5. Single shot or break open

F. Machine guns (capable of full automatic fire)

1. A firearm capable of firing a series or burst of shots with a single pull of the trigger.

IV: Rifling:

A. Series of grooves in the interior surface of the barrel which spiral down its length causing the bullet to spin and travel nose forward for accuracy.

B. General rifling characteristics (GSR). Vary from manufacturer to manufacturer and consist of:

1. Diameter of bore
2. Number of lands and grooves
   a. Their dimensions
3. Direction of twist

C. Manufacturing processes in barrel manufacture:

1. Drill hole for bore diameter
2. Ream hole to exact bore diameter
3. Rifle (cut grooves in bore)
   a. Hook
   b. Scrape
   c. Broach
   d. Button
   e. Hammer forge

V. Extraction & Ejection: Each firearm has some provision for removing cartridges and/or cartridge cases from the breech or chamber to render the firearm unloaded.

DEFINITIONS OF COMMON TERMS

AUTOMATIC - Although commonly used to describe a self-loading firearm, should be termed a semi-automatic , since the trigger must be pressed anew for every shot fired, truly automatic firearms are self-loaders which continue to fire as long as the finger continues to depress the trigger or until empty.

ANTIMONY - Metallic element with the chemical symbol of Sb, atomic number 51, and atomic weight of 121.75 alloyed with lead to harden the bullet; used in modern non-corrosive primer compound; one of the elements which neutron activation analysis (NAA) detects to establish the presence of primer residue.

BALLISTICS - Study of a projectile in motion.

BARREL - Tube that guides the bullet or shot charge; interior passage grooved in rifles and handguns; smooth in shotguns.

BARIUM - Metallic element with the chemical symbol of Ba, atomic number of 56 and atomic weight of 137.34, found in the primer compound; one of the elements detected by the neutron activation analysis (NAA).

BULLET - Projectile of a handgun or rifle; one part of a cartridge; term accurate only when referring to the projectile; Sometimes composed of lead alloy, semi-jacketed or full-jacketed with an outer layer of hard metal, usually a copper-zinc alloy; style variable, e.g., boattail, flat nose, hollow-point, round nose, spire point or wad cutter.

CALIBRE - Ideally, the bore diameter expressed in hundredths of an inch or in mm.; practically, calibre often used in designating the name of the firearm or cartridge. For example, the 32-20 W.C.F. (Winchester Center Fire), 303 Savage and the 308 Winchester are .300 bore as are the well known 30-30 W.C.F., 30 M1 Carbine and 30-06 Government.

CARTRIDGE - One unit of ammunition composed of cartridge case, primer, propellant and bullet; sometimes referred to as one round of ammunition.

CARTRIDGE CASE - The container for all the other components which comprise a cartridge.

CLASS CHARACTERISTICS - A measurable feature of a specimen which indicate a restricted group source. They result from design factors, and are therefore determined prior to manufacture.

FOOT-POUND - A unit of kinetic energy equal to the work required to raise one pound to a height of one foot; unit of measure used to express the energy or power of a cartridge.

GAUGE - Size designation of a shotgun; based on the number of round lead balls of bore diameter that equal one pound. e.g., 12 gauge is the bore diameter of a round lead ball 1/12th of a pound; only exception is the .410 shotgun where bore size is .410 inch.

GROOVE - Spiral cuts or impressions inside a barrel which rotate the bullet and stabilize its flight.

HANDGUN - Short firearm intended to be aimed and fired from one hand. Three basic types:

Semi-automatic pistol - a handgun which fires, extracts, and ejects the fired cartridge case, reloads and cocks itself each time the trigger is pulled.

Derringer - Small handgun; may have one, two or four barrels; fires a single shot from each barrel.

Revolver - handgun with a revolving cylinder chambered to hold the cartridges; cylinder may contain as few as three chambers or as many as twelve, most common number being six.

Single Action - Hammer must be cocked each time before firing.
Double Action - Trigger pull alone will cock and fire the gun.

LAND - Original part of the bore left after rifling grooves are formed; width and number constitute class characteristics.

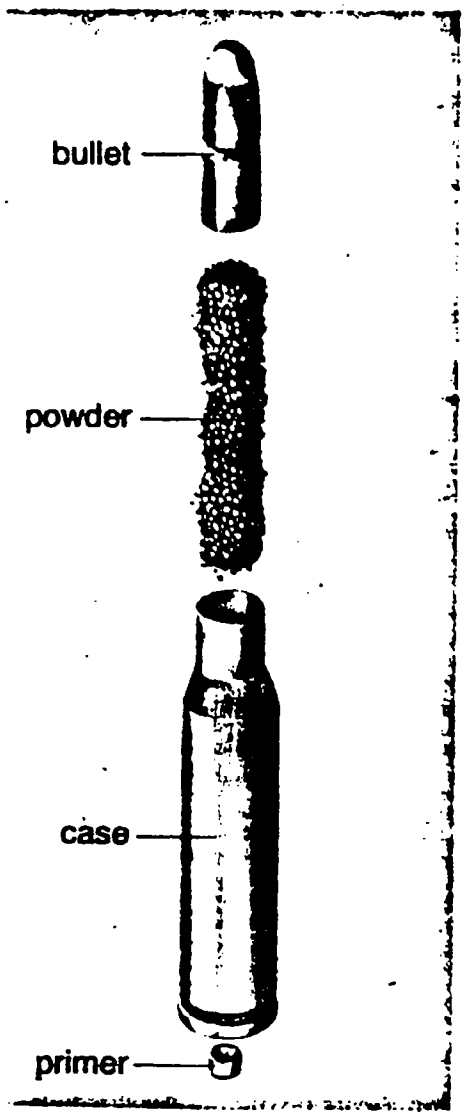
MAGAZINE - A receptacle that holds cartridges stacked on top of one another ready for feeding into a chamber. Some detachable magazines commonly, though inaccurately, are referred to as a clip.

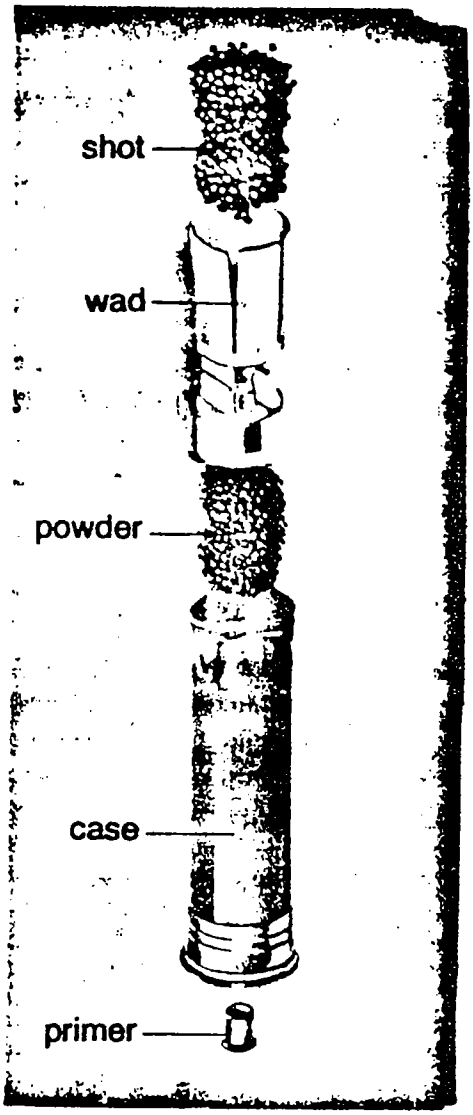
PRIMER - The ignition component of a cartridge. It's compound is variable but customarily contains some or all of the following: Antimony, barium, lead, mercury or potassium.

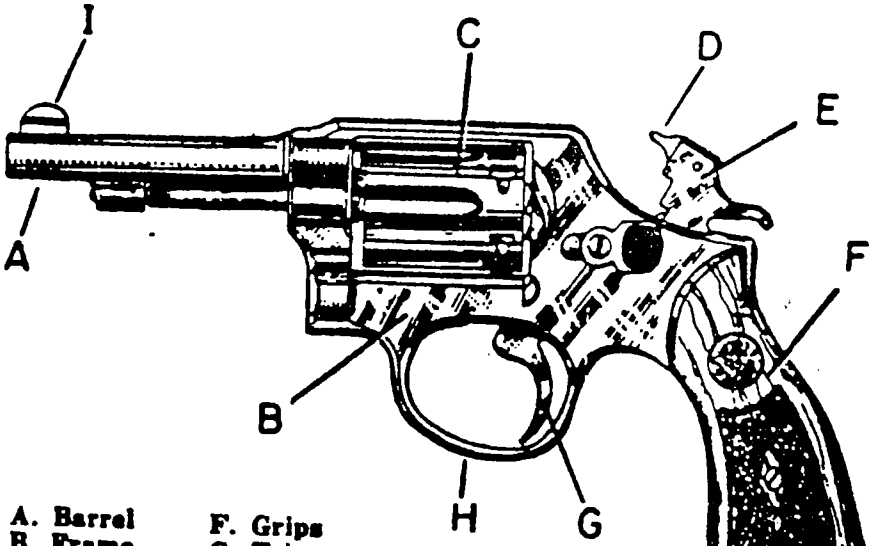
RIFLING - Helical grooves in the bore of a firearm barrel to impart rotation or spin to a bullet.

SHOTGUN - A smoothbore shoulder firearm designed to fire shotshells. Some new shotguns now do have rifling.

COMPONENT PARTS OF CARTRIDGES AND SHOT SHELLS

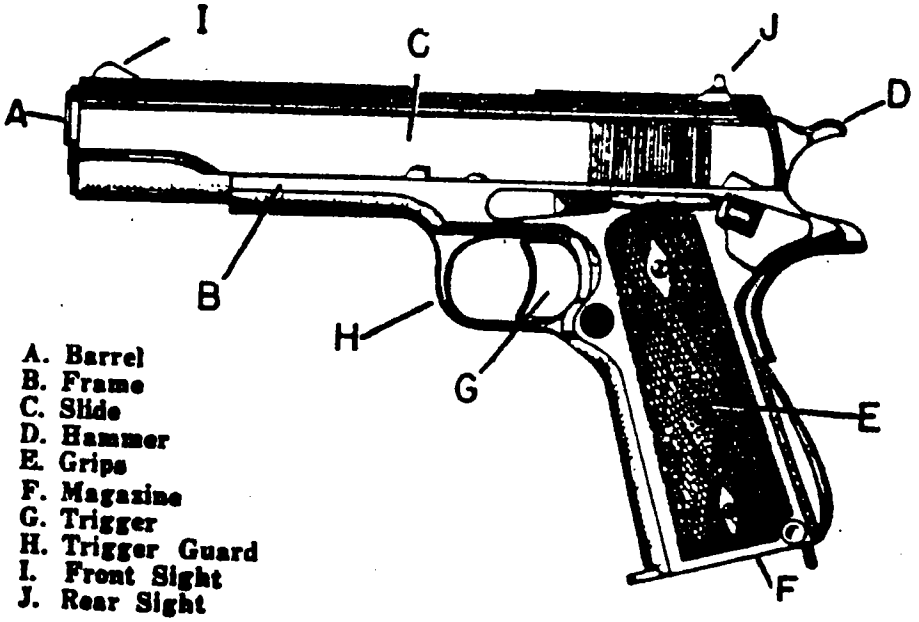






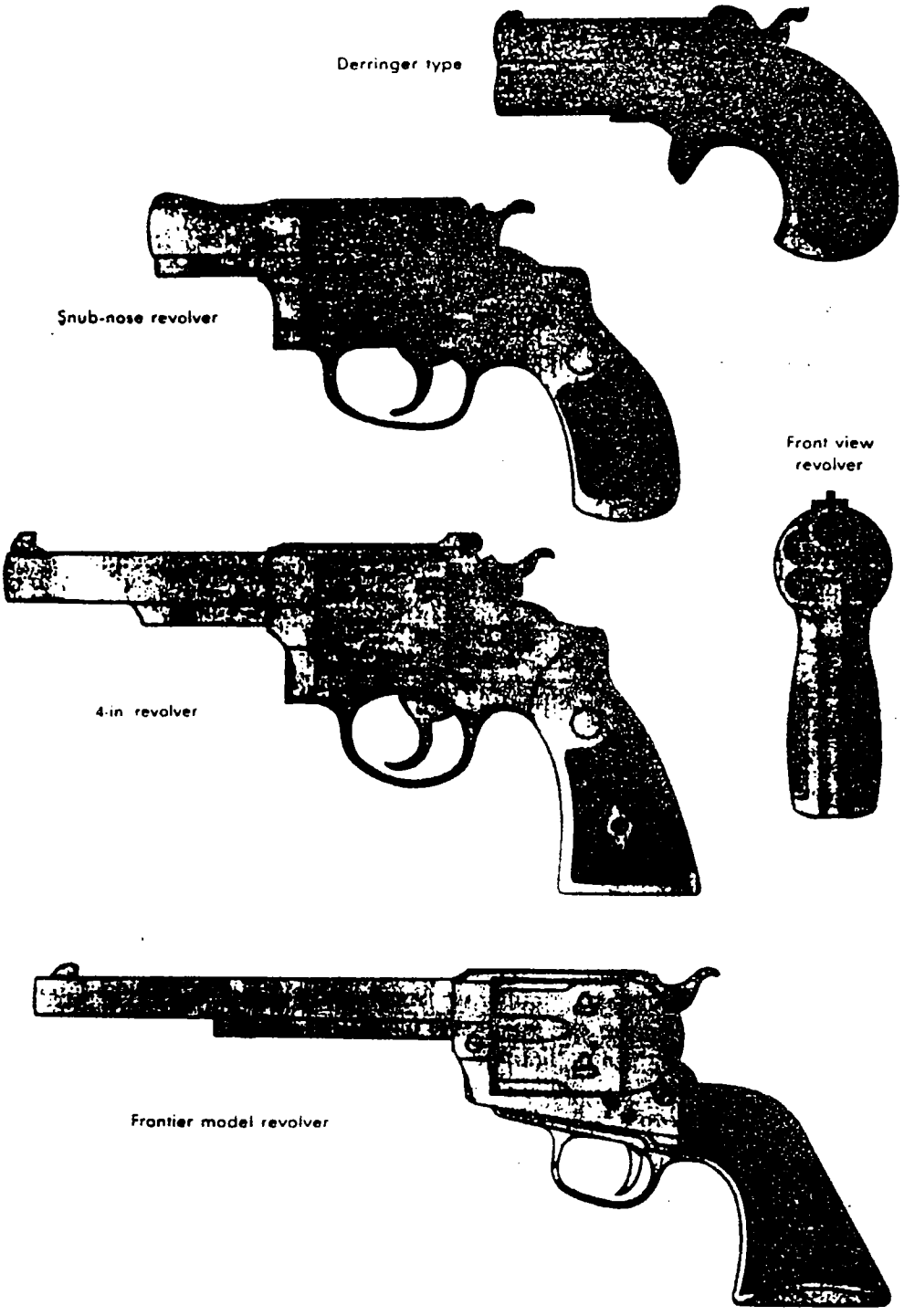
A. Barrel
B. Frame
C. Cylinder
D. Firing Pin
E. Hammer
F. Grips
G. Trigger
H. Trigger Guard
I. Front Sight

REVOLVER

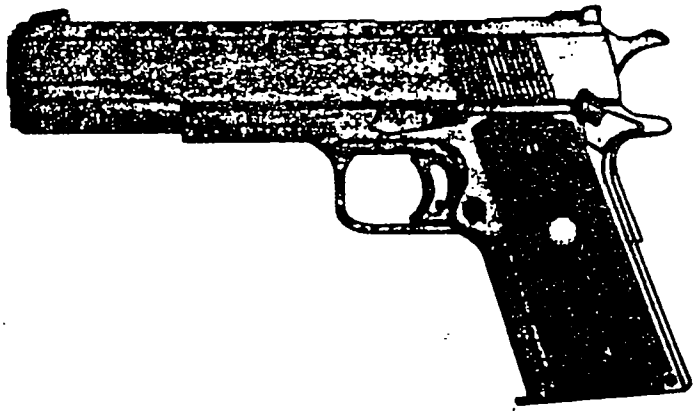


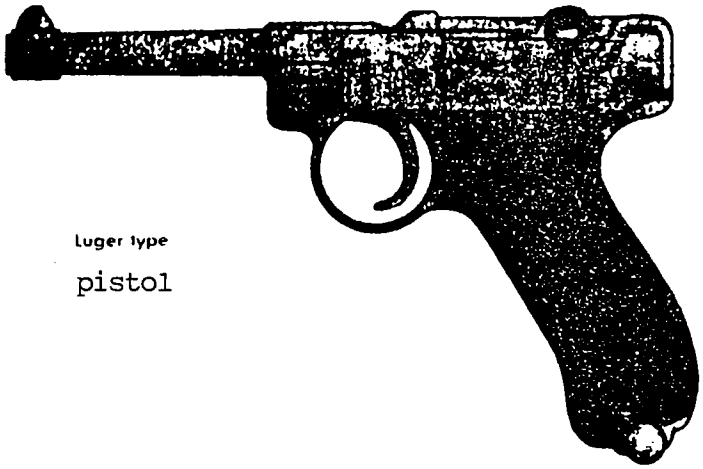
A. Barrel
B. Frame
C. Slide
D. Hammer
E. Grips
F. Magazine
G. Trigger
H. Trigger Guard
I. Front Sight
J. Rear Sight

SEMI-AUTOMATIC PISTOL


Derringer type
Snub-nose revolver
Front view revolver
4-in revolver
Frontier model revolver

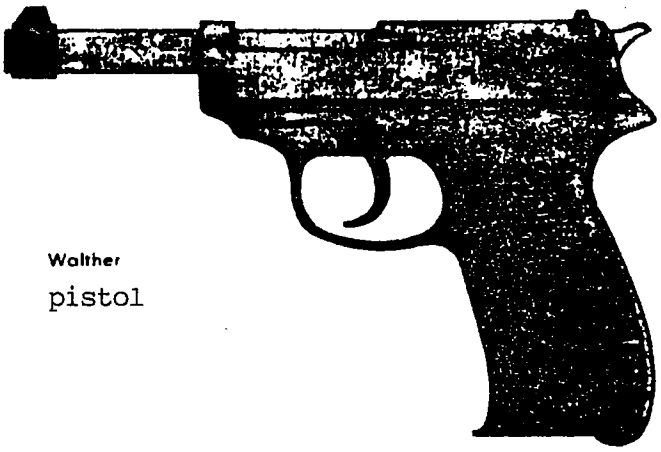
Semi-automatic Pistol





Luger type
pistol

Front view
automatic



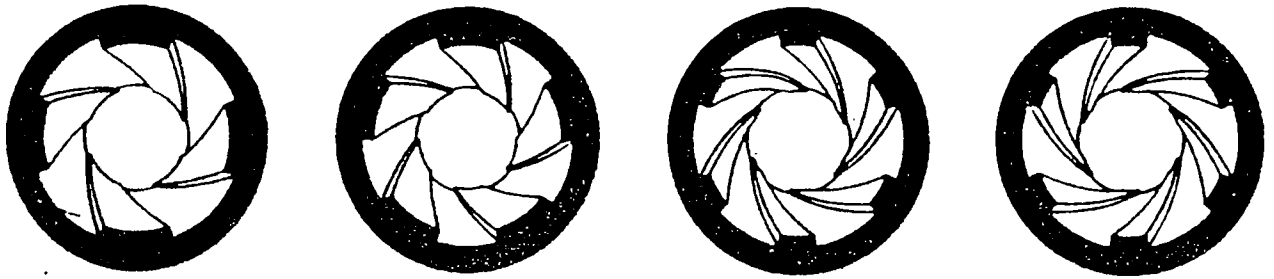
Walther
pistol

CLASS CHARACTERISTICS

COMMON CALIBERS

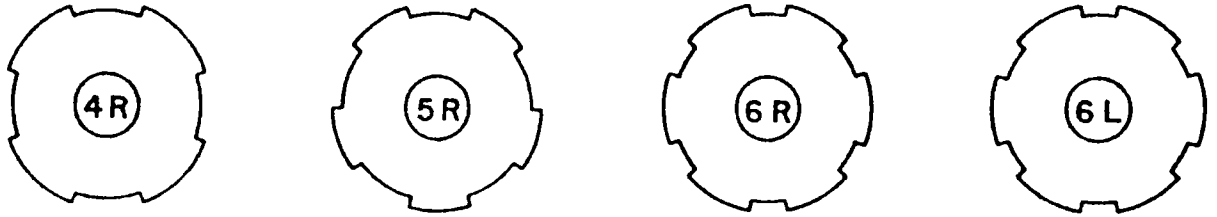
COMMON RIFLING

THE BARREL



THE BULLET

(cross section)



(side view)