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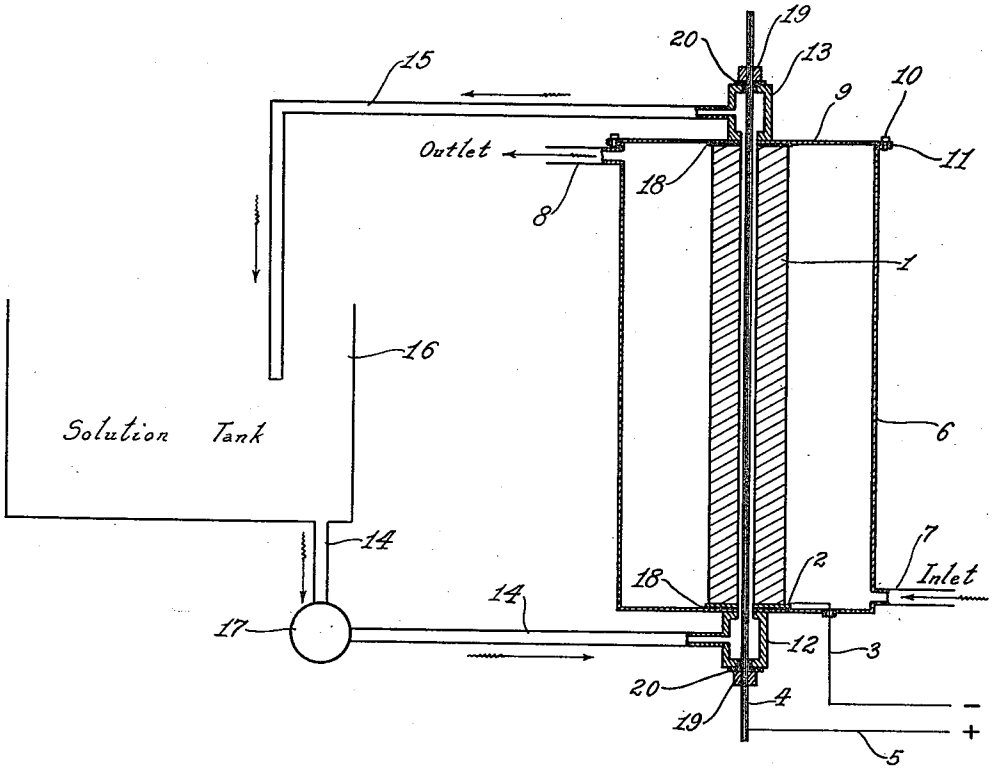

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GUN BARREL AND PROCESS OF FINISHING THE SAME

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This invention relates to gun barrels and more particularly to the finishing of the bore thereof.

A gun barrel is subjected to unusual conditions which affect the maintenance of the bore thereof; for such a bore is not only subject to corrosion but also erosion. The ordinary primer compositions contain potassium chlorate as an oxygen carrier. On explosion of the primer, however, the chlorate decomposes, giving off oxygen, while a chloride remains as a finely divided solid, which not only attacks the metal of the bore, but enters pits in the bore surfaces, thereby causing corrosion or rusting of the steel of which the barrel is made. Even when the bore is cleaned immediately after shooting, traces of the chloride still remain, especially in the pits, so that corrosion is not prevented. Furthermore, the powders employed have a corrosive action on the bore, and this is even true of smokeless powders having a nitro-cellulose base, for oxides of nitrogen are generated by the burning of the powder, and these oxides are very active chemically to dissolve and attack the steel, thereby causing pitting and corrosion. Even atmospheric conditions affect the bore walls, for the moisture in the air permits oxidation to take place so that the steel accumulates rust, thereby causing pitting. After a certain number of rounds of ammunition are fired in a gun, the bore becomes so worn by erosion that it will not have the required diameter, especially in rifles; accordingly, the accuracy is finally so affected that the barrel must be replaced; for it cannot be rebored and still maintain the diameter required for the ammunition for which it is designed. Furthermore, the bore of a gun barrel is subject to adhesion of the projectile in its passage through the bore, which, in case of lead projectiles, is called "leading"; this liability of adhesion increases with corrosion and pitting.

One of the objects of this invention, therefore, is to provide a gun barrel whose bore is so formed that corrosion, pitting and erosion are reduced to a minimum.

Another object is to provide a gun barrel whose bore is plated, preferably with a permanent plating which is hard and practically non-corrosive.

A further object is to provide a gun barrel whose bore can be readily restored to the desired calibre.

Another object is to provide a process whereby the finishing of the gun barrel bore is accomplished in a simple, economical and efficient manner.

Another object is to provide a process whereby the gun barrel bore has deposited on its walls a plating, preferably of a hard and practically non-corrosive metal.

Another object is to provide a process for restoring gun barrels, and particularly the bore thereof, in a simple, economical and effective manner.

Further objects will appear from the detail description, taken in connection with the accompanying drawing, in which—

The figure is a view, somewhat diagrammatical in form, illustrating a gun barrel and a process of finishing or refinishing the bore thereof in accordance with one embodiment of this invention.

In accordance with this invention, the gun barrel bore walls are plated with a metal which is hard and, therefore, subject to a minimum of erosion under the action of a projectile fired through the bore and in contact with the plating; which is non-corrosive, in that it is not attacked by the chemicals resulting from the firing of and under the action of the propellant charge fired in the barrel; and, furthermore, is not subject to rusting, due to the moisture present in the air. A metal which is ideally suited for this purpose is metallic chromium; for this metal is not only extremely hard and resists mechanical abrasion to a marked extent, but it also resists corrosion, in that it is practically unaffected by chlorides and nitric acid and is entirely unaffected by atmospheric conditions. In accordance with this invention, a plating or coating of chromium is applied to the bore walls; the thickness of the plating need, however, only be thin, since it can readily be replaced, as hereinafter described; accordingly, plating thicknesses of from two ten-

thousandths (.0002) to eight ten-thousandths (.0008) of an inch are sufficient for ordinary small arms ammunition; however, thicker platings may be used, if desired, and in ordnance this plating may be as much as or more than five thousandths (.005) of an inch.

Not only can gun barrel bores be originally finished by the application of a coating or plating in accordance with this invention, but worn gun barrels can also be restored; for, by cleaning or reboring the bore to permit the deposit of the plating, this bore can be plated to an extent sufficient to restore the calibre. Even a bore plated in accordance with this invention can be readily restored after corrosion takes place, by simply removing the remanents of the plating and replating the bore walls; accordingly, it is not necessary that the plating be carried on to any extensive thickness on account of the readiness with which the plating can be replaced. It will, of course, be understood that, in the finishing or refinishing of a gun barrel even with great accuracy, the diameter of the completed bore is slightly larger than the desired calibre; accordingly the deposit of the plating on the bore walls is then carried on to an extent sufficient to produce the desired calibre.

The coating or plating of the bore walls can be accomplished in any suitable manner and by any known method; preferably, however, the planting is applied by electro-deposition. In the deposit of chromium on steel, however, difficulties are encountered which require electro-deposition from the proper solution and under proper predetermined conditions, and special appliances or apparatus are desirable and even necessary; for the conditions under which deposit should take place must be closely controlled so that the deposit will have the proper physical characteristics; accordingly, the solution, the temperature, the current density and the relation between the anode and the cathode must be controlled.

In accordance with this invention, the plating is deposited on the bore walls while the plating solution is circulating therethrough in order that the proper concentration may be retained. A proper predetermined temperature should also be maintained during the plating operation. The electrode, and particularly the anode, should extend inside of the bore, but uniformly spaced from the bore walls; and it is preferable that the surface area of the anode have a certain ratio with reference to the surface area of the bore walls.

An apparatus suitable for carrying out the process embodying this invention will now be described; it will, however, be understood that this apparatus is simply illustrative of one of the many embodiments which may be employed to carry out the process. Referring to the accompanying drawing, 1 designates a gun barrel, which may be a rifle barrel, and this barrel may be connected to the negative pole of a suitable source of electric current by a contact 2 through a suitable conductor or wire 3. An anode 4 consisting of a lead rod or wire is connected to the positive terminal of the source of supply by a conductor 5. The barrel is surrounded by a water jacket 6 having an inlet 7 and an outlet 8 so that water may circulate therethrough, and the top of this water jacket has a closure 9 which is attached in any suitable manner, as by screws 10 passing through a flange 11 so that the barrel may be inserted; it will, however, be understood that any other suitable, quickly detachable fastening means may be provided. Couplings 12 and 13 attached to the bottom and top of the water jacket are connected with pipes 14 and 15 leading from and to the electrolyte solution tank 16, and a pump 17 is preferably interposed in the pipe 14 in order to circulate the solution through the barrel; however, circulation may be maintained in any suitable manner, as by gravity or thermo-siphon action. Packing washers 18 may be provided to seal the ends of the barrel from the water jacket. The anode 4 is maintained centrally of the bore by being suspended in the ends of the couplings 12 and 13, and suitable nuts 19 may be clamped on or threaded on the anode so as to hold it in position. The ends of the couplings may be closed by suitable insulating and packing washers 20.

The solution employed may be any of the standard solutions used in electro-plating chromium, an example being the following:

	Ounces per gallon
Cromic acid CrO_3	33
Chromium sulphate $Cr_2(SO_4)_3$	0.4
Chromium carbonate $Cr_2O(CO_3)_2$	1

This solution is circulated in the direction of the arrows from the solution tank up through the bore between the bore walls and the anode, and while this electrode is maintained centrally along the bore, but out of contact with and insulated from the walls. This circulation is necessary, for the volume of the solution within the gun barrel is small on account of the necessary space taken up by the anode, and the solution in the barrel would, accordingly, be depleted quickly unless its metallic content were replaced; this is accomplished by the circulation, whereby the concentration of the solution may be maintained substantially constant, even though the volume in the solution tank be small. This concentration may, however, be maintained by the addition of additional electrolyte of the proper concentration. It will, of course, be understood that the solution tank is provided with a suitable stirring device so that the concentration throughout the tank will be maintained uniform. The provision of the water jacket enables the re-

quired temperature to be maintained, and it will be understood that a suitable thermometer and even automatic temperature control may be provided. The temperature is preferably maintained at about 113° F. The anode is of such a diameter that its surface area is about one-half (½) of the surface area of the bore, and it is centered so that it is equi-distant from the bore along its entire length. With the apparatus as described, the deposit is continued until the desired thickness of plating is secured. It will be understood that the bore is treated prior to deposition in any suitable and known manner, and with any suitable solution, so as to permit the plating. In case of worn barrels, it will be understood, of course, that the bore is rebored to take out the pitting, and the deposition is then continued to an extent sufficient to restore the calibre.

It will, therefore, be seen that the invention accomplishes its objects. By coating or plating the inside of the gun barrel with a metal as described, not only is abrasion and erosion greatly retarded, but corrosion is practically eliminated. Not only is the plating substantially non-corrosive under the action of a propellant charge when fired in the barrel and substantially non-erosive under the action of a projectile fired through the bore and in contact with the plating; but the plating being smooth as well as hard and maintained in polished condition, the friction between the projectile and the bore is reduced and maintained at a minimum. Corrosion, as well as fouling, due to adhesion of the projectile to the bore walls in passing therethrough, is obviated; this is not only true where soft projectiles of lead are used, but also where jacketed or plated bullets are employed. Accordingly, not only is the life of the barrel increased, but its initial accuracy will be maintained for a longer period. Moreover, the barrel, after having its bore worn, need not be discarded, but can be refinished to its original condition. Due to this ready refinishing, the plating need not be of any extended thickness, but can be a mere film.

While the invention is particularly applicable to small calibre rifles, it is by no means limited to such arms, since it is readily applicable to rifles of larger calibres, pistols, revolvers, and shot guns. It is even applicable to ordnance in that the life of large calibre guns can be considerably increased by plating and replating the bore in accordance with this invention. It is, therefore, to be understood that the expression "gun barrel" is used descriptively and not limitatively. Furthermore, while chromium is particularly applicable and has the desired characteristics rendering it ideal as a plating for the walls of the bore, other metals having the desired characteristics and physical properties may be used. Furthermore, while the plating or coating is preferably accomplished by electro-deposition, it will be understood that it can be accomplished in any other manner well known to those skilled in the art; however, electro-deposition is the most satisfactory, gives the required accuracy, and can be readily controlled.

It is further obvious that various changes may be made in details, within the scope of the appended claims, without departing from the spirit of this invention; it is, therefore, to be understood that this invention is not to be limited to the specific details shown and described.

Having thus described the invention, what is claimed is:

1. A gun barrel whose bore has a plating of metallic chromium.

2. In the art of finishing gun barrels, the process comprising, completing the bore to the approximate diameter and depositing metallic chromium on the bore walls.

3. In the art of restoring gun barrels, the process comprising, reboring the gun barrel and depositing metallic chromium on the bore walls to an extent sufficient to restore the calibre.

4. A gun barrel whose bore has deposited therein a substantially permanent plating of metallic chromium which is substantially non-corrosive under the action of a propellant charge when fired in the barrel and which is substantially non-erosive under the action of a projectile fired through the bore and in contact with the plating.

In testimony whereof we affix our signatures this 23rd day of June, 1927.

JOHN M. OLIN.
ALFONS G. SCHURICHT.