to penetrate and get to both sides of the cast. When the molds are all cast, and the whole has dried a sufficient time, comes the most delicate part of all—getting the molds off the cast. For these will not pull from the plaster cast any more than they did from the clay. In this case, however, it is not the cast but the molds which are broken in removing them, and now the significance of the colored layer in the mold becomes apparent. The caster, working away at his molds with mallet and chisel, is safe so long as only white chips fly; as soon as he gets to the colored layer, he goes most carefully, knowing that immediately beneath it lies the cast. The molds are taken off in many pieces and thrown away; their function finished, what remains is a plaster cast, exactly like the original clay, which may be shipped away to the bronze factory (as the clay could not be shipped) there to have molds made in many pieces into which the bronze is poured.

Large statues like the one illustrated take several days to cast both mold and plaster cast, and at almost any time, the labor of months of sculpturing may be ruined by careless work. Of course, molds are broken in making and statues in plaster are chipped. These accidents are not necessarily ruinous, as breaks in either mold or finished cast can be repaired. But the destruction of the clay that the plaster mold may be made, the destruction of the mold that the plaster cast may emerge, like a butterfly from the cocoon, is a delicate operation, and one mistake in the caster's art or one slip of the chisel may mean, if not destruction, at least grave danger to the success of the whole. Hence it is that the craftsmanship of the caster takes for a while the place of the artist, and becomes as much a necessity to the production of the finished likeness as all the skill within his fingers.

A New Form of Underwater Attack

A Torpedo that Carries a Gun

By Robert G. Skerrett

WITH the exception of some ships now building or planned, the thousands of tons of armor plate carried upon modern fighting craft are designed exclusively to combat passively the attack of various types of gun-fired projectiles. Below the load-line, these vessels depend for security upon the surrounding water, so far as the attack of artillery is concerned. The torpedo has commonly in the past been considered so limited in its range and so uncertain in its performance that but little weight has been attached to it by the partisans of the gun. Battle ranges seemed logically to keep the torpedo in the background, except at night, when the speedy torpedo-boat counted upon getting near enough to launch its weapons with a more reasonable promise of getting home a hit. The naval constructor, accepting the torpedo at its potential value as seen by the majority of the fighting officers, simply limited his efforts to frabricating the under-body of his fighting craft so that the damaging effects of a chance blow from a torpedo should be confined to a restricted area. Hence the inner and the outer bottoms, and the water-tight, cellular divisioning of the intervening space. As a matter of fact, the naval constructor's work stood up under torpedo attack and performed its function remarkably well. It is a matter of record, that the general run of torpedoes fired during the Russo-Japanese war did far less damage than was expected of them, and a goodly number of vessels so struck were not sunk as was counted upon, but were able to get into port and be repaired.

There were ships lost to both belligerents by subaqueous attack, but the most conspicuous of these disasters were due to the violent blows of passive mines. Where the active torpedo had failed in its mission the anchored, floating mine filled the offensive gap. These mines carried larger explosive charges than the torpedoes then in service, and proved two things: First, that the naval constructor had planned well, and, second, that the automobile torpedo must needs be made a more powerful weapon if it were to fill the office intended for it.

In the Russian fleet at Port Arthur were several vessels that had been built by the French for the Russian Government. In addition to the usual compartmenting of the inter-bottom space, the French designers had reinforced the region most likely to be attacked by torpedoes by means of a caisson built of plating nearly two inches thick. The object of this caisson—assuming that the explosion of the torpedo should be sufficient to rend or rupture the plating of the inner and outer bottoms—was to provide more space in which the guncotton gases could expand and dissipate the most dangerous percentage of their remaining force. The ingenious theory of this style of construction was proved to be all that its originators claimed for it. The Russian ships so built were several times hit by Japanese mines, and, while greviously wounded over wide areas of their under-bodies, yet the caissons remained substantially intact, and the vessels were able to return to harbor. The Russian and the Japanese battleships that were sunk by means of mines went to the bottom suddenly, because the force of the bursting mines was sufficient to detonate the neighboring magazines; but it is not believed that the vessels lost in this way had the protection of caissons immediately next to the double-bottom space.

The immediate result of the lessons taught by the Russo-Japanese war—so far as they concerned underwater attack—was a widespread realization that the automobile torpedo would need some radical modifications if it were to make good in the future. Apart from the desirability of greater speed and greater range, the most conspicuous need was the power of delivering a more damaging blow when once in contact with its target. To that end, the size of the weapon was progressively increased in order that it might carry a bigger bursting charge of guncotton in its warhead. This desideratum has been realized; but the bursting charge of the biggest of the present day automobile torpedoes is not as large as that of the mines which damaged the ships of both belligerents during that conflict.

As a matter of fact, the more recent dreadnoughts have the under-water protection of the caisson or its equivalent, and one can't help but ask, "How does the increased charge of the warhead meet the requirements of to-day?" In addition to this, armor is being added to the defense against torpedo attack, and this is placing the underwater weapon at a still further disadvantage. Its chances of spreading havoc deep enough to affect a ship's vitals are more remote relatively today than they were during the struggle between the Russians and the Japanese. It is manifest that there is a big gap in this line of attack which the Whitehead and its various kindred rivals cannot fill, and here it is that the genius of an American, Commander Cleland Davis, of the United States Navy, provides us with an answer and places the torpedo upon a new and a more formidable footing.

Commander Davis has blazed a new path in the art. He has abandoned the guncotton warhead, which has been the accepted instrument of destruction since the inception of the Whitehead, and has substituted a gun in its stead. If one will study carefully the photographs of either bursting submerged mines or exploding automobile torpedoes, the most impressive visual sign of the violence exerted will be found in the great volumes of water blown heavenward. The water has yielded more than the steel structure attacked, and the major part of the energy designed to wreck has spent itself uselessly in blowing hundreds of tons of water into the air. Commander Davis has sought to so concentrate the powers of assault in his torpedo that but little of its force should be dissipated in disturbing the surrounding water while the bulk of the energy of his weapon should remain unimpaired and centered in piercing the enemy's defenses and penetrating to the very vitals of the object of attack. Commander Davis does not discount in the slightest the truly remarkable developments which have taken place in the other departments of the automobile torpedo. Increased range, higher speed, and more precise functioning all help him toward his objective; but it is his invention which makes this underwater projectile a graver menace to the biggest and the best of fighting craft.

The Davis torpedo, recently tested in the waters of the Lower Chesapeake, carried an 8-inch gun capable of expelling an 8-inch projectile with a muzzle velocity of something like a thousand feet per second. Ordinarily, an 8-inch gun strong enough to fire a shell with this velocity would be far too big and too heavy to be placed within the permissible limits of a torpedo. We are speaking of a piece of ordnance to be fired in the open air. Now, the Davis gun, when fired, is surrounded by the sea, which, so to speak, reinforces the walls of the gun, but this is not all. The weapon is made of vanadium steel, which has a very high elastic limit, and this great strength on the part of the metal makes it possible to construct a gun of seemingly ridiculous lightness. This fact has made the new torpedo practicable.

The muzzle velocity of a thousand feet a second is quite enough to carry the projectile through a single plate of Krupp armor, something like four or five inches thick when virtually in contact with the muzzle of the gun—as would be the case with this torpedo. Now, ships are not protected under water with plating of these dimensions, and it would be a much easier task for the projectile to pass successively through a number of thinner plates even if their combined thickness were more than the limit set. The projectile fired from this new torpedo carries a bursting charge of high explosive of between 35 and 40 pounds. This charge is detonated by a delayed-action fuse, which is designed to meet the maximum requirements imposed by the best protected dreadnoughts built, building, or projected. Our illustration represents the Davis torpedo attacking a ship of the Danton type of the French navy; vessels that typify recent practice, and which have the protecting caisson that saved some of the ships of the Port Arthur fleet from sinking when they hit the Japanese mines planted outside of that port. In our picture we see the shell piercing the five opposing bulkheads of steel, passing through one of the coal bunkers, and bursting in a boiler room. We must leave to the imagination the dreadful aftermath of this attack and the destruction of a boiler charged with high-pressure steam. The same shell might have hit either farther aft or farther forward and bored its way right into a magazine or a shell room, the consequences of which would be even more appalling. The disturbed water has been occasioned by the escaping propulsive gases from the gun, which have served to tear a big rent in the outer plating of the bottom of the ship, and the liberated air from the torpedo's air flask. The surface disturbance is very modest compared with that which either a submarine mine or an automobile torpedo of the usual types would produce.

The diagram under the picture represents the Davis torpedo, and shows a longitudinal section through only that part where the gun is installed. When the weapon has been launched upon its sinister errand the little propeller at the upper side of the torpedo's nose revolves and releases the tripping rod, so that the torpedo can be discharged upon contact with its target. When the rod hits the obstruction it is driven backward and engages the trigger which first compresses a spring attached to the firing pin and then releases it so that the pin can strike the gun primer, thus setting off the propelling charge of powder which drives the shell out of the gun. As soon as the projectile hits the outside plating of a ship's bottom the fuse in the base of the shell begins to function, being set to explode the charge in the shell so many hundredths of a second after impact. During the recent tests in the Chesapeake, the projectile first pierced the target from side to side, passing through a couple of armored bulkheads en route, and then exploded in the water beyond. The second attack was against that side of the target which was further protected by a plate of three-inch steel. The shell exploded at the instant of impact, and did not pass into the target, but the structure was so damaged that it sunk shortly afterwards. The lesson of the second attack laid stress only upon the fact that the fuse was not properly timed, otherwise the shell would have entered the caisson and exploded inside, doing still more damage. This is merely a matter of refinement, and does not qualify the startling possibilities which the Davis gun-torpedo suggests. In the future, in order to safeguard ships against attack of this sort hundreds of tons more of armor must be placed upon every fighting craft, and this must add greatly to their displacement and their cost, or be provided at a sacrifice of other vital features.

The Fire Sprinkler—Plain Business Proposition

FIRE COMMISSIONER JOHNSON, of New York, says: "As a business proposition the most effective fire prevention appliances which the Fire Department can order installed mean dollars saved to the owner of the large factory or other place of business. I refer to automatic sprinklers. Fire prevention experts agree that automatic sprinklers, coupled with a device for sounding an alarm direct to fire headquarters, form the best known method for preventing destructive fires. Experience of many years shows that automatic sprinklers rarely fail to hold fire in check until the department apparatus arrives to put on the finishing touches." In two thirds of these cases the fire is completely put out by the time the department gets there.