SALVAGE OF THE UNITED STATES CRUISER "YANKEE" BY COMPRESSED AIR.

The present attempt to raise the United States auxiliary cruiser "Yankee" is the first application to a United States warship of the method of salvage by compressed air used by Mr. John Arbuckle. The system has already proved its efficiency in the case of the raising of the steamship "Bavarian," of 12,000 tons, after she had run upon the rocks in the St. Lawrence River.

In both the old system and the new, the raising of a sunken vessel is accomplished by removing sufficient water from the hull of the ship to give the necessary buoyancy for flotation. Under both methods, the space within the ship that is rid of this water is filled with air; but there is this important difference, that under the ordinary method the air is at atmospheric pressure, whereas under the Arbuckle method it is under a pressure equal to the depth of the hold or compartment from which the water is driven out.

In raising ships, it has been customary to send down divers who, by means of patches of plating, plugs, wooden caissons, cement, etc., attempted to patch up the hole in the hull, and render the ship fairly tight. When these repairs had been completed, powerful pumps were installed upon the ship, or upon wrecking vessels moored alongside, and sufficient water was pumped out to lift the ship off the rocks and enable her to be towed to the nearest drydock.

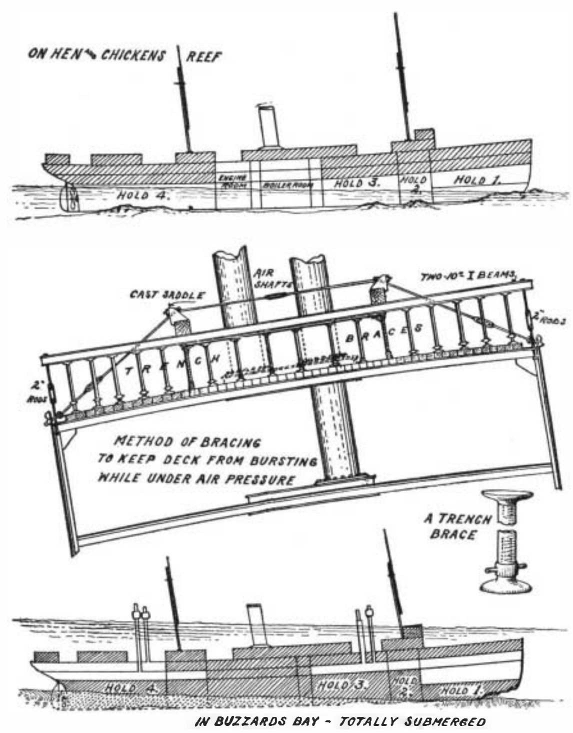
It frequently happened, however, that the perforations of the hull were so many or of such extent, sometimes large portions of the bottom being torn entirely away, that salvage by the pumping method was practically impossible. This was due largely to the fact that the patchwork—plugs, canvas, cement, and whatnot—was exposed to an inward pressure corresponding to the depth of the injured portion of the ship below water, which pressure was so great as to exceed the resisting strength of the temporary repairs.

It occurred to Arbuckle a few years ago that there was no reason why the compressed-air method, as used in driving tunnels below the East and Hudson rivers, should not prove effective in the salvage of sunken ships; for, if the mud, silt, and water can be held from entering the open end of a tunnel by opposing against it an air pressure equal to the water pressure at that level, it seemed probable that the water could be expelled through the perforated bottom of a ship, and held permanently at the level of this perforation, by the same use of compressed air.

Although it necessitates some exceedingly difficult engineering work and the exercise of considerable ingenuity, the method by which the compressed air is used for freeing the ship of water is simple and easily understood. No attempt is made to close the perforations in the bottom of the hull, but great care is taken to render airtight the sides and roof of the various holds and compartments. Air-supply pipes are led into the various compartments, and compressed air is forced in and the water gradually expelled through the bottom, until the level of the water in the various holds has been driven down to the highest point at which the hull has been perforated. It is evident that as long as the air pressure is maintained, the water cannot re-enter. By estimating the capacity of the compartments thus treated, and knowing the weight of the vessel, it is possible to free the ship of the exact amount of water to bring her to the surface and make her float at some predetermined draft.

The "Yankee" is one of four merchant ships built between 1890 and 1892, which were purchased during the war with Spain and transformed into auxiliary cruisers. Latterly she has served as a torpedo supply ship. She is 392 feet long, 48 feet 4 inches in breadth, and draws 20 feet of water on a displacement of 6,225 tons.

In the autumn of 1908 she was run upon the Hen and Chickens Reef at the entrance to Buzzard's Bay and badly wrecked, holds 1, 2, 3, and 4 being badly perforated, as shown in the accompanying diagram. The Navy Department endeavored to float the ship by the customary method of closing the holds and pumping, but failing to get her off, they abandoned their efforts, and called for bids by private wrecking companies. The condition of the ship was generally considered to be hopeless, and John Arbuckle was the only bidder. Operations were commenced on October 21st, 1908. The berth deck throughout the whole length of the ship was made thoroughly watertight, and the water was driven out of holds 1, 2, 3, and 4 by compressed air, the engine and boiler rooms being emptied by pumping. The vessel was floated after forty-five days of operations, and was being towed into New Bedford when, unfortunately, the weather became very boisterous, and a tug, in going alongside the "Yankee," was driven against the portholes of the room containing the air-compressing machinery and



In the two diagrams of the "Yankee" the portions of the ship from which the water was expelled are shown in white.

RAISING THE "YANKEE" BY COMPRESSED AIR.

stove them in, and the water flooded the compartment and stopped the compressors. The vessel slowly sank at a point one mile east of the Dumplings in Buzzard's Bay at the entrance to New Bedford Harbor, and lay in the position shown in our various engravings. The bow of the vessel was a few feet below the water, but the stern lay thirty feet below the surface.

In the new salvage operations, it was decided to leave the lower holds, the engine and boiler rooms, and the greater part of the gun deck full of water, and lift the ship by expelling the water from the upper portion of hold No. 1, from the whole of the berth deck, and from the after portion of the gun deck. Reference to the engravings will explain the conditions of flotation, the unwatered areas being shown in white. The first step was to make special steel hatches, fasten them securely in place and calk them thoroughly watertight. The gun deck being of steel, was sufficiently watertight in itself, but the after portion of the spar deck, being of wood and having comparatively little resisting strength against the upward pressure of the air, it became necessary to reinforce it strongly. This was done by placing above the spar deck and upon the deck house a series of 10-inch I beams arranged in pairs, which extended the full width of the vessel. At its outer ends each pair of beams was anchored down to the waterway at the side of the ship by 2-inch iron rods set up with turnbuckles. Upon the beams, immediately over the side walls of the deck house, two 12 x 12 timbers were placed parallel with the axis of the ship. Upon the outer edges of these beams were set special cast-iron angle blocks, which were tied together with 2½-inch rods. From each angle block on each side of the deck house a pair of 1½-inch truss rods was carried down and made fast to eyebolts which passed through the side plating of the ship and were held in place by nuts. Between the under side of the I beam and the spar deck was placed a number of trench braces, which were set up until they bore snugly against the spar deck, thereby serving to transfer the upward pressure of the air to the system of trussed I beams as above described.

The special steel hatches were provided with openings to which were coupled five large steel airshafts, which extended above the surface of the water and were provided at their upper ends with air locks. The wrecking plant consists of a large schooner, which is fitted up with living accommodations for the men; a big wrecking steamer, upon which is installed a compressor plant capable of delivering 5,000 cubic feet of free air per minute; a number of ship's boats, and a steam tug which makes regular trips between New Bedford and the scene of the wreck, two miles out in Buzzard's Bay. The difficulties of the work are greatly enhanced by the exposed position of the wreck, and there are necessarily many days when it is impossible to do any work.

These remarkable salvage operations have made excellent progress. The sections of the ship to be unwatered have been made airtight, the truss bridging over the spar deck is completed, and it is expected that very shortly, as soon as a favorable conjunction of wind and tides is presented, the "Yankee" will be brought to the surface and towed into drydock. Considering the great depth of water in which the ship lies, her salvage will be one of the most remarkable feats of its kind in the history of wrecking operations.

A GASOLINE ENGINE FOR CORN HUSKING.

BY FRANK C. PERKINS.

At slight expense, by the development of the gasoline motor, the farmer is now enabled with modern labor-saving devices to do many times the amount of work formerly possible. The accompanying illustration shows the use of a small portable gasoline engine mounted on a simple four-wheeled truck in operation just outside of the barn, driving a corn husker by belt transmission.

Thousands of acres of corn are not cut up, but husked from the stalk, thus entailing an entire loss, except for the fertilizing value and a small amount of feed.

With a motor-driven husker located at the barn, it is a simple matter to "jerk" the stalk corn, a process which is speedier than husking, and to shovel it into the machine by which the ears are husked. The husks are blown to the mow or barge, made of wire fencing. They can afterward be baled and sold at a good price to mattress manufacturers, the husk alone netting a good profit, while the feeding or fertilizing value of the stalks is not materially lessened.

For operating the husking machine, only a four to six horse-power gasoline engine is required, while it is stated that hundreds of bushels of corn have been husked by a machine of this type with only a three-horse-power engine under favorable conditions. In central Ohio a four-roll machine has been able to husk 250 bushels in a day, requiring four teams and one extra man, besides the three men that operate the machine, with a cash outlay of twenty-five dollars per day. It is stated that one of these small husking machines operated by a light gasoline engine will handle the same 250 bushels at less than half the expense, or $11.50. This motor-driven husker is of the two-roll type, the rolls being four feet in length and large in diameter. It runs at high speed, thereby greatly increasing the capacity, which is about 20 bushels per hour, under normal conditions, but has been operated at over 30 bushels without difficulty. It is stated that the average run is from 7 to 10 shocks (12 hills square) per hour.

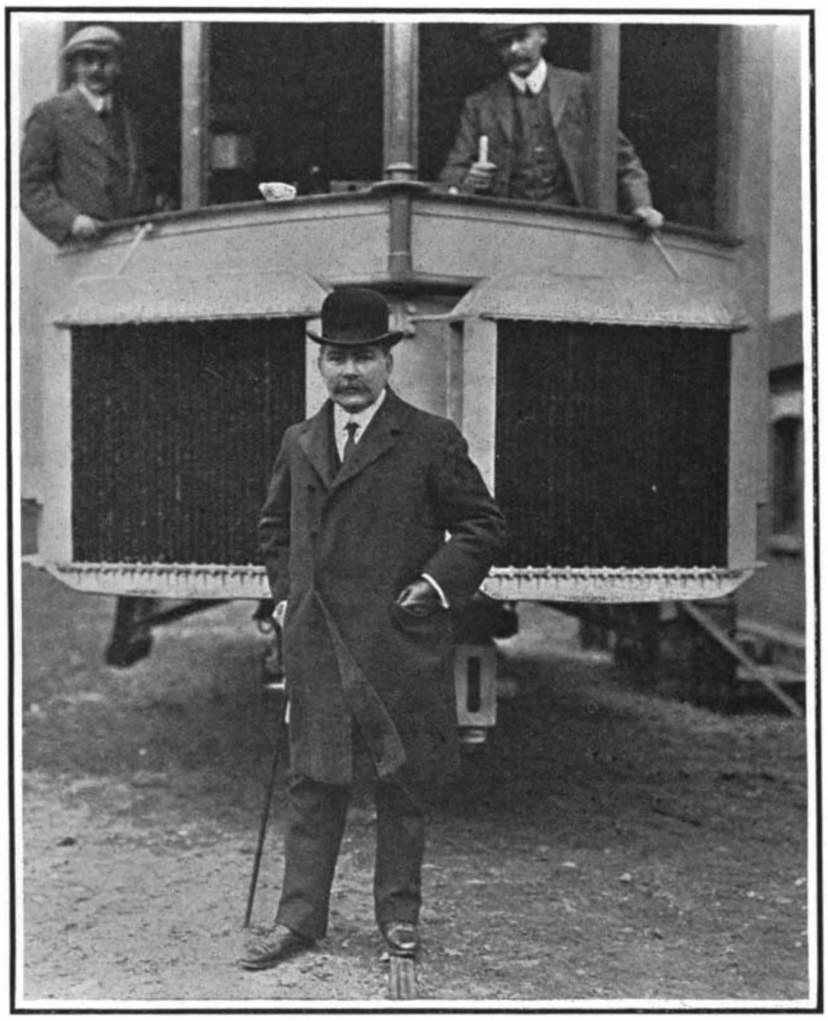
A GASOLINE ENGINE FOR CORN HUSKING.

The shredder head is composed of knives strung on a shaft 11/16 inch in diameter, held in position so that only one knife strikes at a time. The knives strike with a shear cut each 2½ inches on the stalk, leaving the blades in good condition.

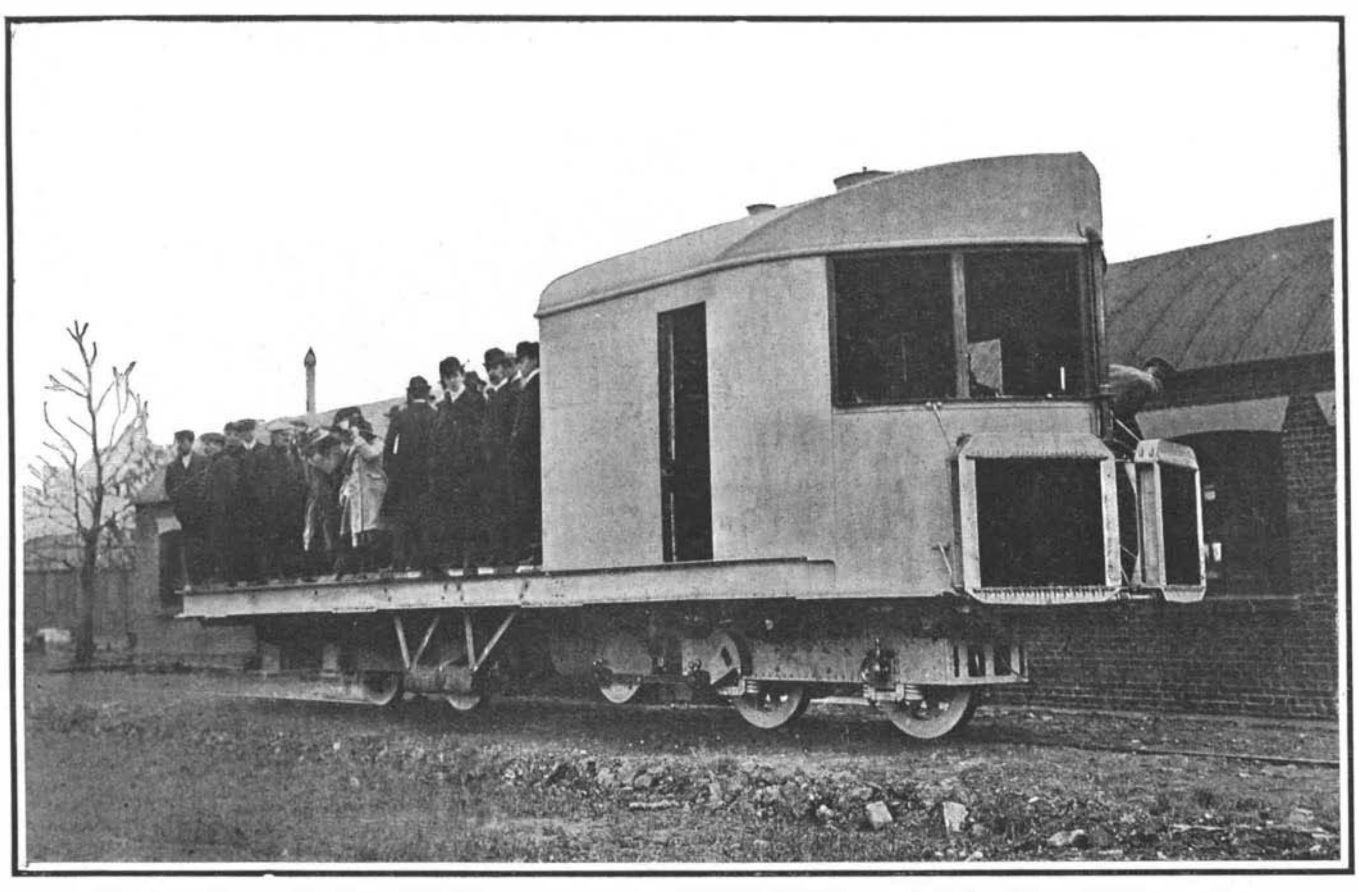
The blower is arranged at the rear of the machine, so that all the stover must pass over the screen. About 16 feet of 9-inch pipe is connected to the machine. A bevel gear is used for driving the corn elevator, which is so constructed that the receptacle for receiving the corn is out of the way, in driving up to the machine with a load. The power is disengaged as well as the rolls by the simple movement of a lever attached to a spiral plug.

THE GYROSCOPIC MONO-RAILROAD.

In the spring of 1907, Mr. Louis Brennan, inventor of the Brennan torpedo, exhibited before the Royal Society of England a small car which traveled on a single rail or cableway, and kept its equilibrium perfectly even while rounding curves and when its load was shifted from one side to the other. This feat, an apparent defiance of the laws of gravity, aroused a great deal of interest, and it was predicted that it marked a revolution in railroad practice. The car was kept in equilibrium by means of a pair of wheels, that were rotated at high speed in opposite directions. The gyroscopic effect of these rotating masses prevented the car from toppling over, in the same way that a top is kept from falling while spinning at high speed. Since the first exhibition of the gyroscopic car, Mr. Brennan has been at work developing details, which would permit of using the same principle on a much larger car suitable for carrying heavy loads. A couple of weeks ago Mr. Brennan's invention, now reduced to practical dimensions, was again exhibited before the Royal Society. The car was 14 feet long, 13 feet high, and 10 feet wide. weighing 22 tons. Carrying a load of 40 passengers, the car traveled on a single rail around a circular track 220 yards in circumference. The balance was perfectly kept by means of two gyroscopes weighing three-quarters of a ton each and revolving at a speed of 3,000 revolutions per minute. The wheels were incased and ran in a vacuum, so as to reduce friction to a minimum. A gasoline engine was used, to keep the gyroscopes spinning and also to propel the car. The car was subjected to the severest of tests, the passengers suddenly shifting from one side to the other in their endeavor to destroy the equilibrium, but the gyroscope wheels responded to the slightest disturbance, and restored the balance at once. One of the difficulties encountered in a car of this type is the precessional action accompanying the gyroscopic motion. This, however, was overcome by means of friction devices. The advantage of using a monorail is that the cost of construction is considerably less; but in addition to this there is the fact that a slight deviation from a true line would result in no damage, whereas when two parallel tracks are used they must both be kept perfectly parallel and in perfect alignment, otherwise the car will run off the track or will rock violently if one side dips below the other. In other words, a double-rail track is more difficult to keep in repair than two monorails, for the reason that the two rails are interdependent, and variation in one must not take place without a corresponding variation in the other. In rounding curves there is always danger of spreading the tracks where a double-rail track is used, while with the monorail line, should the side thrust be sufficient to shift the rail, there would be no tendency for the car wheels to leave the track. As yet the details of Mr. Brennan's latest model have not come to hand, but we expect in an early issue to give our readers a more complete description of this interesting type of railway.



Mr. Louis Brennan standing in front of his gyroscopic monorail car.



The fourteen-foot Brennan gyroscopic monorail car recently exhibited before the Royal Society, London.

THE GYROSCOPIC MONO-RAILROAD.

The Chemistry of Soldering Agents.

BY A. LIPPMANN.

The following summarizes the results of two years' practical experiments with soldering agents, chiefly those of the "soft" type which are suitable for electrical work, where it is necessary for the security of the service to keep within definite limits the resistance introduced and the heat generated at the points of junction. The requirements of mechanical strength, however, demand that the surfaces of contact of the wires shall be sufficiently extended to satisfy the condition of low electrical resistance, and when we consider that ordinary tin and lead solder has a specific resistance 10 or 12 times that of copper, it becomes evident that the chief function of the solder is not to conduct electricity but to protect and maintain the contacts of wire, and to preserve the copper surfaces from oxidation.

There is a traditional belief that hydrochloric acid and other acid soldering liquids should not be used in electrical work, because acid left on the joint by a careless workman may, especially during the passage of a current, give rise to secondary electrolytic actions which will in time destroy the connection. Investigation of many imperfectly soldered joints, however, has failed to indicate any injurious effect due to acids, and has revealed causes of very different character. In most cases of large wires traversed by strong currents, insufficient contact had caused overheating of the joint and fusion of the solder. In some instances the trouble was attributable to the formation of electric arcs between wires which were not held closely together by the solder.

No injury due to the employment of acids could be detected even in resistance coils. With the fine wire used in these coils injuries are far more likely to be caused by careless handling (overheating or burning during the operation of soldering) than by acids.

These considerations lead me to form a lower estimate of the injurious action of acid soldering liquids than is commonly entertained. The investigation in question was undertaken primarily to settle a dispute concerning the relative safety of two soldering liquids, of which one contained ammonium chloride and the other zinc chloride. The difficulty of deciding the question had been increased by the circumstance that an injurious action had been attributed to the hydrochloric acid contained in both soldering agents.

The first requirement for making a good connection by soldering is the presence of absolutely clean metal surfaces. If diluted hydrochloric acid is employed as a soldering liquid a good connection can be made between surfaces not originally quite clean. Many coppersmiths use dilute hydrochloric acid exclusively in fine art work. Experience shows that no injurious after effect need be feared if the soldered joints are well washed with water. The notion that hydrochloric acid is difficult to remove is disproved by the great volatility of the acid. Ammonium chloride (sal ammoniac) is inferior as a flux to hydrochloric acid, and also to zinc chloride and zinc ammonium chloride.

I made experiments in soldering with a preparation of ammonium chloride, to which ammonia was added, drop by drop. The efficiency of the soldering liquid visibly diminished as the proportion of ammonia increased. Soda lye, added to neutralization, made the liquid entirely unfit for use. Hence I attributed the good effect of ammonium chloride to the hydrochloric acid which is gradually separated in the operation of soldering. Experiment showed, however, that ammonium chloride does exert an injurious action on copper. When a mixture of ammonium chloride solution with glycerin was employed in soldering heavy copper cables to each other or to sockets, it was found almost impossible to prevent the liquid from penetrating between the wires of the cable. I examined many such joints two weeks, three weeks, and six months after soldering. In two weeks the wires of the core had become covered with a thick green coating of copper salt. I at first attributed the formation of this salt exclusively to the action of free hydrochloric acid, but Samter has shown that ammonium salts possess a remarkable power of forming complex combinations with copper.

Zinc chloride, zinc ammonium chloride and soldering soaps containing these salts may be regarded as the standard soldering agents. Zinc

(*Concluded on page 399.*)