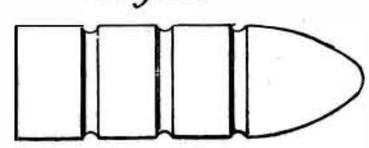
is unnecessary. The primers are gently pressed into the shell and the shell is ready for loading.

The bullet is of certain length and diameter and is made in perfect steel moulds of an alloy of lead and antimony, in the proper proportion to give the proper hardness. The ball also contains grooves which reduce the friction in the barrel and are filled with grease to lubricate the barrel, as in Fig. 8. The required amount

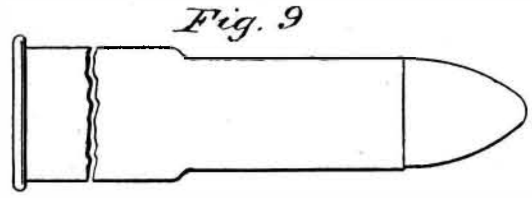
Fig. 8.



of powder is put into the shell and then wadded by a disk of pasteboard of proper diameter and the bullet pressed into the open end over the wad, thus completing the cartridges, which are neatly packed for the market.

Bottle-neck shells are made by a simple process of drawing; they appear as in Fig. 9, and the object is to

Fig. 9



increase the amount of powder without increasing the size of the ball, it being only necessary to increase the size of the chamber in the barrel.

Tapering shells are also made by forcing them in and out of a series of tapering dies. The only object is to facilitate or help in extraction, but the advantage gained is slight in comparison to the expense of the extra operations to make tapered shells. Slight taper and straight shells are mostly used.

The principal standard calibers are 22, 28, 32, 38, 40, 41, 45, and 50; the 28 is obsolete, as it was only used in a pistol made by E. Remington & Sons; the 45 is the regulation of the United States regular army; the 50 is that used by privates of the N. G. S. N. Y.

A large number of these can be carried with convenience. The principal factories in the United States are the Winchester Repeating Arms Company and the Union Metallic Cartridge Company, of Bridgeport, Conn. The firms have facilities for turning out or producing many thousand cartridges daily.

The soldier or marksman has simply to insert the cartridge, lock the breech block, pull the trigger; the concussion of the hammer, aided by the fire pin, explodes the fulminate in the rim or primer as the case may be, which ignites the powder of the shell, generating a large quantity of gas in an infinitesimal space of time, driving the ball through the rifled barrel, giving it accuracy, impulse, high velocity, force, penetration and destructive effects. S. W. ARMINE.

Whitestone, L. I.

PORT'S UNIVERSAL WRENCH.

THE universal wrench, a recent French invention, is a tool of singular originality that has required on the part of its author very laborious work in combinations presenting numerous practical difficulties.

The problem, in fact, consisted in grouping a large number of ordinary multiple tools, of varied forms, in a single piece, and in such a way that such grouping could be effected without necessitating an apprenticeship on the part of the person using it. Such is the work of patience realized in the combination under consideration.

As the accompanying figures show, the universal wrench comprises a series of tools in everyday use in almost all trades—the monkey wrench, the ax, the adz, the hand saw, the screw driver, the vise, etc.

Fig. 1 represents the wrench complete and capable of being used for turning nuts of all sizes and of serving as a hammer. The apparatus thus condensed may be taken apart in eleven pieces. The two jaws, one of which is fixed and the other movable, are of tempered steel. The handle is of varnished wood traversed by a square steel rod. The body of the wrench is of bronze.

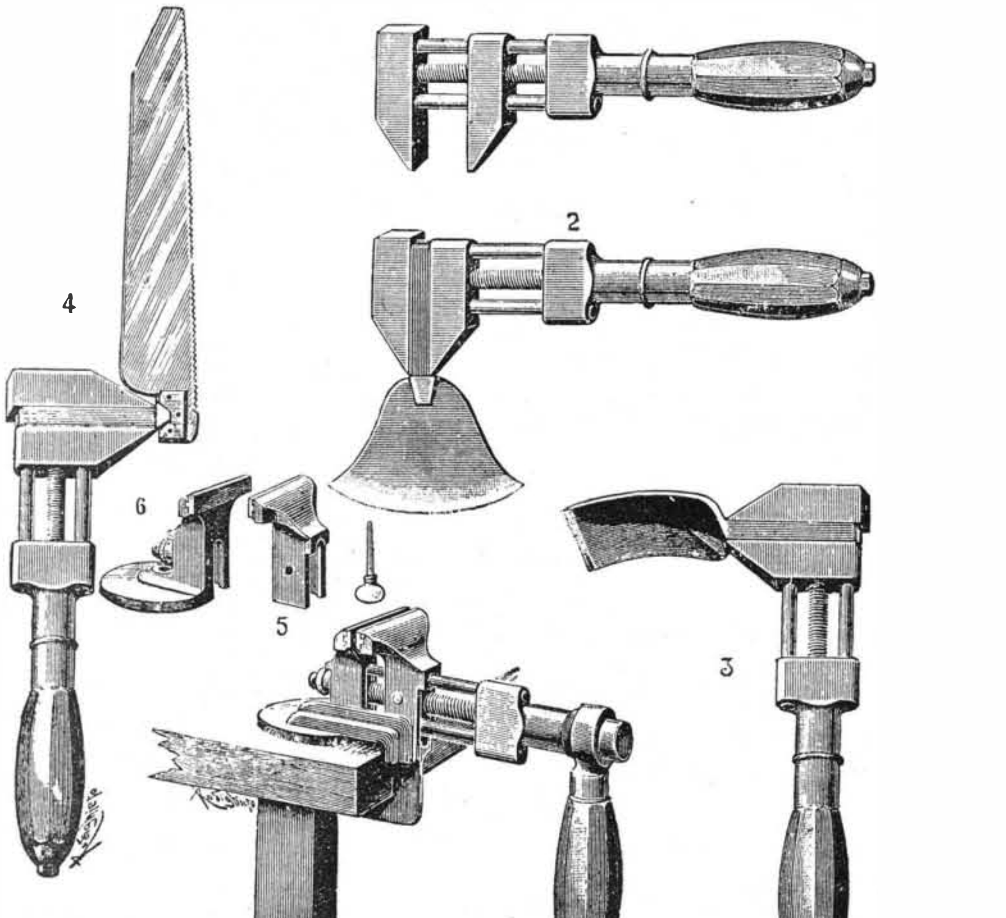
In order to convert the wrench into an ax, adz, saw, etc., it suffices to place the tool that it is desired to use between the jaws, and then screw up the wrench. The number of tools capable of being adapted to the wrench is somewhat indefinite. A pick or shovel even can be fixed to it.

The conversion of the wrench into a very strong vise capable of regular and practical operation is one of the most ingenious combinations of Mr. Port's invention. Such conversion is effected by means of two movable bronze bits with steel clamps that engage in the jaws of the wrench. The figures show the vise fixed to a table, as well as the different pieces of which it is composed.

As the pressure that may be exerted between the jaws by means of a small key is very strong, the wrench may be used for chasing, embossing, and threading and cutting tubes, etc., by means of small matrices that are very easily adapted to the tool.

All the parts are interchangeable, and can be readily replaced, if any one of them becomes worn.

Upon the whole, this very simple little apparatus realizes for mechanics a progress that merits notice. Several tentatives in this direction had already been made, but without success, their authors having abandoned the idea in face of the difficulties to be surmounted.—*Le Genie Civil.*



PORT'S UNIVERSAL WRENCH.

BLOCK SIGNALS.*

A GREAT deal has been written on this subject during the past year; railroad officers have given more attention to it than ever before, and the American Railway Association (formerly called the General Time Convention) has appointed a committee to consider and recommend a standard block signal system, involving as it does the very safeguard to the reputation of any railroad that attempts to meet the demands of the traveling public for high speed and safe transportation.

The English or Sykes system is the one now generally in use. Does it meet the requirements and give the necessary security? To answer this question let us first give, briefly, the method of protecting trains by this system, with which, however, a great many of you are familiar.

Each office is supplied with a semaphore signal; the lever controlling the arm is locked—an operator desiring to give a signal to an approaching train must ask the operator in advance to unlock his lever; the signals between block stations are given by bell code on some roads, and on others, where the locking arrangement is not used, by the regular Morse code. As soon as the train passes into the next block, the operator places his signal to indicate danger, the lever being again locked. He then signals the operator in the rear that the train has passed out of the block. On crowded roadways, and especially where trains are "closing up" on approaching the great terminal points, these signals must be given instantly, so as not to detain the following train. Herein lies a very great danger. This was brought more forcibly to my mind by reading the very able article written by Mr. Theo. N. Ely, general superintendent of motive power of the Pennsylvania Railroad, and published by *Scribner's Magazine* for March, on the subject of train speed.

Mr. Ely claims that "speed at the rate of one hundred miles an hour is no longer a question of motive power, but one of transportation facilities and methods;" and, after calling for a perfect roadbed, "the alignment almost free from curvature, etc.," he says, "one hundred miles per hour is made possible, but only upon the fulfillment of one other condition, namely, a clear track ahead."

All talk on the question of such a high rate of speed may appear to be based on theory, but if you will consider for a moment that our "limited" trains of to-day are scheduled at an average of about fifty-three miles per hour (this, of course, includes all stops, adding the time thus lost to that which is lost in climbing heavy grades, running slow through cities, towns, etc.), these trains must maintain an average of more than sixty miles per hour, and this means seventy-five and eighty miles per hour on the best running grounds. And, further, the high speed of our fast freight trains and the distance covered by such trains after the brakes have been applied for an emergency stop will, I think, convince all of you that we are surely and rapidly advancing to the high limit now set, and that our block signals have not kept pace with it.

This brings up the question, how soon, after receiving warning of danger, a train running at this speed can be stopped. Accepting the figures given by Mr. Ely (for I am sure we recognize in him a competent authority), it is estimated that a train running at the rate of sixty miles per hour with full braking weight of the train and rails in the most favorable condition could be brought to a full stop in 900 ft., at eighty miles per hour in 1,600 ft., at ninety miles in 2,025 ft., and, finally, at one hundred miles per hour in 2,500 ft.

You will observe that these figures are based upon the most favorable conditions, but such conditions cannot be relied upon. Starting a train, either passenger or freight, from Buffalo, with every part in perfect order and weather clear, the load may be heavier on one day than on another, making it harder to stop, and before that train reaches New York the brake shoes are worn, the leverage is strained and pulls unevenly, the track is wet and slippery along the Hudson, and the fog obscures the signal until the train is very close to it. Should we not then base our figures on the most unfavorable conditions? and, again quoting Mr. Ely, ask that "the train receives its warning at least three-quarters of a mile before it must halt"?

Now, coming back to the point of danger, the operator has "cleared" his block, but the train has only gone 1,000 ft. into the next block, and, from some cause, has stopped. Before this is discovered the fast train following has been given a clear signal at the station in the rear and covers the 4,000 ft. between the two signal stations in about twenty-seven seconds; there the engineer finds the signal in danger position and applies the brakes, but, according to Mr. Ely's figures, the momentum and weight of that train will carry it at least 1,500 ft. beyond where the preceding train has stopped, and the result is a collision.

An effort has been made to meet these new conditions by placing a signal back into the block (commonly called the overlap) to indicate the position of the home signal; this is also operated by a lever, interlocked and included in the combination governing the system. This will lessen the danger, but with this mechanical arrangement the signal cannot be placed back far enough to entirely eliminate the danger. Another point of danger is that an operator can unlock the signal in the rear if his own lever has been unlocked, and thus permit a second train to come into his block.

The Hall Signal Company now have an improvement on the Sykes system which covers this point, and is arranged so that a train in passing out of the block depresses a track instrument; this is connected electrically with the unlocking device, so that it is necessary for at least a part of the train to pass out before the lever can be unlocked.

There is still another and greater chance for an error in this system, as well as in all other non-automatic systems. We must depend upon the operator to see that all of the trains pass out of the block. As you well know, all trains carry "markers," to denote the last car; the operator is expected to see the markers and to not report the train clear until he does see them. If the train has broken in two parts and the first part goes by the office and the operator fail to notice the absence of the markers, it is quite probable he will report "train clear," and the following train will be admitted to the block under a clear signal to find the detached portion of the preceding train unprotected by a flag, as the trainmen depend upon the block signal, and do not get very far from their caboose. It is claimed for the Sykes system that two persons must make a mistake before a wrong signal can be given. This is true in so far as the unlocking part is concerned; but, as I have shown in the case of a train stopping soon after passing the block, an accident is possible even with all regulations obeyed, but in the last case one man makes the error by failing to see the markers.

The arrangement of the pneumatic system seems to cover these points, but I believe the same protection is afforded by any other system that is operated by a track circuit, and with very much less machinery to get out of order.

If we then conclude that the present systems must be improved to secure absolute safety, what will be the system of the future?

Will it be entirely automatic, by means of the rail circuits?

Will it be electro-pneumatic, with an attachment to the last car, or will it be, as a writer in the *Railway Equipment Guide* for April suggests, "a system that will display signals continuously throughout each block, so that the signal to proceed or stop will always be in view of the engineer." This idea strikes me very favorably. With such a system the operator controls a line of signals for a certain distance in the blocks each side of his station. In any event, it is my opinion that electricity will play an important part in the block signal of the future, and as the superintendent of telegraph, or division operator, is the man to whom elec

* Read at the eleventh annual meeting of the railway telegraph superintendents, Denver, Col., by J. B. Stewart.—*Journal of Railway Appliances.*