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R. T. CATLIN ET AL
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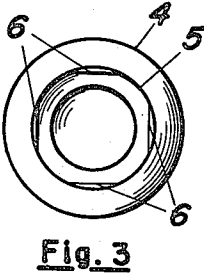
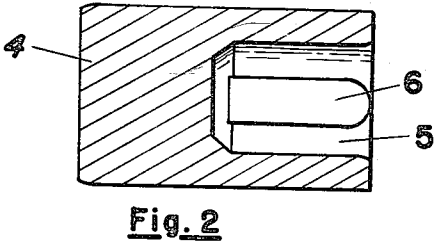
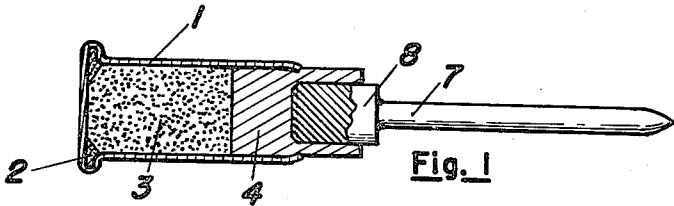


Fig. 8



Fig. 9



Fig. 10

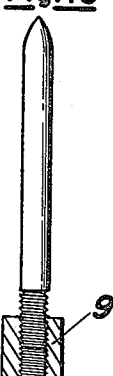


Fig. 11

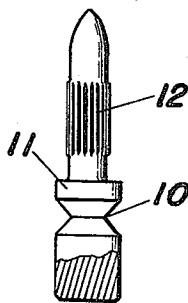


Fig. 4

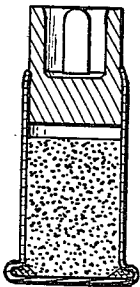


Fig. 5

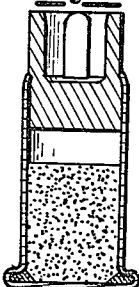


Fig. 6

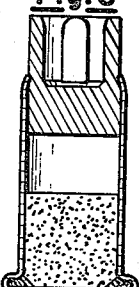
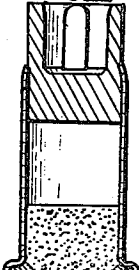


Fig. 7



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AMMUNITION

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7 Claims. (Cl. 102—38)

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This invention relates to ammunition intended for use particularly in the industrial stud driving tool shown in the co-pending application of Merle H. Walker, Serial No. 225,146, filed May 8, 1951, now Patent No. 2,645,772, and other tools intended to meet the need filled by the said Walker tool and those shown, for example, in the patents to Dunn, No. 2,504,311; Sopris, No. 2,518,395; and the several Temple patents, of which No. 2,479,431 is illustrative.

In order to adapt such tools to the widest range of usefulness, there must be available for use with each tool a wide variety of types of industrial studs or fasteners, several tool manufacturers stocking not less than 23 types for use in their tools. In addition, special materials, as stainless steel, and/or special surface finishes such as copper or cadmium plating are often required for use under corrosive conditions multiplying the stock requirements by the number of special materials and finishes carried. For use in securing building materials, wiring devices, and the like, to such widely varying structural materials as steel, concrete, or wood, it is obviously necessary to have available some means of controlling the penetrating power of the stud or fastener. In the past, this end has been achieved by the use of specially loaded cartridges and by means of complicated modifications of the driving tool such as barrel vents or variable area or variable volume expansion chambers. If cartridges are loaded as fixed ammunition with all the types of fasteners, a tool user's inventory of cartridges becomes impracticably large.

The object of our invention is to produce more efficient ammunition for such tools and, at the same time, to simplify the inventory problem of the tool user.

We contemplate that these objectives can be best attained by loading at the factory as semi-fixed ammunition a series of standard cartridges of progressively greater power. Each of these cartridges may be crimped to a plastic sabot provided with a specially shaped recess designed to receive and releasably retain any of the wide variety of studs or fasteners which may be used. The most convenient means of identifying the power of the various loads is the adoption of a color code for the plastic sabots. The studs or other fasteners may be separately stocked and require no greater care in handling or storage than nails or other building hardware.

The requirements of a particular job determine the stud to be used and operator experience plus an occasional test shot determine which

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driving cartridge to employ. Once that determination has been made, the number of rounds necessary for the complete job may be assembled by inserting the heads of the required number of the selected studs into the recesses in the sabots of a corresponding number of cartridges of appropriate power.

The exact nature of the invention as well as other objects and advantages thereof will become apparent from consideration of the following specification referring to the attached drawings in which:

Fig. 1 is a longitudinal sectional view through a cartridge and stud assembled ready for use in the driving tool.

Fig. 2 is an enlarged cross-sectional view through the sabot shown in the cartridge of Fig. 1.

Fig. 3 is an end elevational view of the sabot shown in Fig. 2.

Figs. 4, 5, 6, and 7 are longitudinal cross-sectional views showing cartridges corresponding to that shown in Fig. 1 but assembled with progressively smaller charges of propellant powder.

Figs. 8, 9, 10, and 11 are elevational views, partially in section showing some of the varieties of studs which may be used in any of these cartridges.

Referring to the drawings by characters of reference, it will be seen that Fig. 1 illustrates a complete round assembled ready for use in the driving tool. The components of this complete round are a cartridge case 1, which may be either of centerfire or rimfire type. As an example, we have illustrated a rimfire cartridge similar to that identified in the trade as Caliber .32 Long R. F., which has a priming composition 2 deposited within its rim. This cartridge is loaded with an appropriate charge of propellant powder 3, which is retained in place by a plastic sabot 4, inserted into the mouth of the shell 1, and retained therein by moderate crimping or other deformation of the shell mouth. As best seen in Figs. 2 and 3, this sabot is in the form of an open-mouthed cup having a relatively massive heel and a recess 5 of a size and shape adapted to interchangeably receive and resiliently retain any of the complete line of studs.

Complete interchangeability is the result which flows from the characteristics of the material chosen for the sabot, which should be tough and resilient, and from the shape and size of the recess 5. This recess, although outwardly of cylindrical form, is provided with a number

f flats 6 of such dimensions that an inscribed circle tangent to each of the flats will be of slightly smaller diameter than the head of any stud which may be used. At the same time, the inside diameter of the circular portion of the sabot is greater than the major diameter of any stud which may be used. Thus, any stud such as 7 which is seated in the recess 5, as shown in Fig. 1, engages the flats 6 and, in spreading them to permit entry, distorts the circular portion. The resiliency which is inherent in all of the materials found suitable for use as sabots results in the secure retention of the stud until firing. The exact relationship of the diameter of the head 8 of the stud, the major inside diameter of the sabot and that of an inscribed circle tangent to the flats, is not critical, providing that the diameter of the stud is intermediate the other two diameters. This construction also provides a means for the escape of air which would otherwise be entrapped in the recess at the time of assembly of stud and cartridge. Experiments have indicated that the setback of the stud against entrapped air may split the sabot on firing.

The sabot has several functions in addition to that of supporting the stud. These are the protection of the propellant powder against atmospheric moisture and the provision of a perfect gas seal on firing. Both of these functions contribute to ballistic uniformity.

In addition to resilience, the desirable characteristics of material for sabots are toughness, impact resistance, and stability over a wide temperature range, e. g., 150° F. to -20° F., and during long term storage. In general, a volatile plasticizer is undesirable. In addition, if color coding is to be utilized for load identification, the material should be available in a wide range of stable, unmistakable colors. Obviously, cost, strategic availability, and moldability are also factors which must be considered.

Of the suitable materials, ethyl cellulose (particularly Hercules #477) has seemed preferable, although certain grades of nylon and certain polystyrene compositions, particularly those produced by the U. S. Rubber Company under the trade name "Kralastic" and understood to incorporate a rubber plasticizer, have been useable alternatives. Certain cellulose acetate butyrate compositions, particularly that known as Tenite No. 2, have met all physical specifications with the possible exception of loss of plasticizer which might cause deterioration if cartridges remained in relatively high temperature storage for several years. On the other hand, all grades of polyethylene which were tried appeared to be too soft and, even when protected by an overpowder card wad, tended to extrude past the head of the stud. Certain other plastics, although satisfactory when first loaded, were found to incorporate volatile plasticizers which tended to evaporate in storage and to result in dimensional instability and embrittlement of the sabot.

Although variable over wide limits, the thickness of the solid heel of the sabot should be adequate to prevent extruding into the recess of an internally threaded fastener such as shown in Fig. 8 and to prevent blanking out the center and extruding the peripheral portion past the head of the fastener. A minimum thickness of $\frac{1}{8}$ of an inch is desirable with even the strongest materials used. Obviously, the longer sabots, both as to total length and as to length engaged with the fastener, will better perform their guiding function.

When a cartridge of this type is fired in the driving tool, the resilient solid heel of the sabot upsets under pressure to prevent the escape of gas and maintains the stud centered in the barrel. The driving tools used with such cartridges are almost invariably fired with the muzzle in contact with the work, are frequently slightly counterbored at the muzzle, and usually provided with a diametrically enlarged guard to prevent blow-back and spall fragments reaching the operator. The usual result is for the sabot to remain on the head of the stud within the counterbored portion of the barrel. In firing, the sabot will usually be fitted more tightly to the head of the fastener, and this is desirable for otherwise the sabot may be pulled off when the gun is removed and remain in the barrel. Although a sabot so remaining in the barrel does not create an explosion hazard, it will be blown out ahead of the following fastener and the pieces will inevitably fly out to the sides.

For practically any use, some one of a series of five cartridges will be found adequate. In Fig. 1, we have illustrated a cartridge with a maximum load shown for convenience as completely filled with propellant powder, although that is not usually the actual situation. Considering this maximum load as 100 percent, the others illustrated in Figs. 4 through 7 may be loaded with charges varying by about 15%, resulting in loads having respectively about 85%, 70%, 55%, and 40% the penetrating power of the maximum load. This series of loads has been identified by the use of sabots molded from colored plastics—for example, purple has been used for the maximum load while red, yellow, green, and brown, respectively, have been used to indicate the progressively reduced charges.

In sizing up a particular job, a tool operator will probably know by experience about which charge to use and, in any event, can find out by reference to an operator's manual or by one or two test shots. He can then proceed to assemble at once all the cartridges he will need for that particular job or take a box of cartridges of the selected power and a handful of studs and assemble, load, and fire each shot in turn.

The stud 7 illustrated in Fig. 1 is one of the several types which may be used and has a simple solid head 8. Such a stud might be used in various lengths for nailing wood furring or electrical conduit, for example, to a masonry wall. Other styles are illustrated in Figs. 8 through 10 showing respectively an internally threaded head, and two sizes of externally threaded heads. To enable ready use of the small externally threaded design shown in Fig. 10, an adapter bushing 9 may be threaded onto the shank. Fig. 11 illustrates another variation in the head which is sharply notched at 19 to permit breaking off all but a relatively small unobtrusive head portion 11. This figure also illustrates a type of shank which is particularly useful in securing items to steel beams and other structural metal work. As such a shank penetrates metal, the displaced metal flows around the knurls 12 and securely anchors the stud in place. These figures by no means exhaust the possibilities in alternative stud and fastener designs and are intended only to be illustrative. In carrying out our invention, it is only necessary that the head or an adapter thereon be of substantially cylindrical form having a diameter intermediate that of an inscribed circle tangent to the flats 6 and the major inside diameter of the sabot. Gen-

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erally, it is desirable for the outside of the head to have a surface which is at least slightly roughened to assist in retention of the sabot thereon after firing. A rough turned surface is acceptable for this purpose.

Since the studs are generally most useful when applied to those materials so resistant as to defy the use of nails and screws, they should obviously be made of good grade heat-treated steel hardened to such an extent as to resist upsetting during use. We have found, for example, that SAE No. 4037 steel which has, after finish machining, been heat treated by quenching in oil from between 1525 and 1550° F. and tempered to a hardness in the range of Rockwell "C" 51 to 54, is highly satisfactory. A case hardening treatment producing equal or greater surface hardness while retaining more toughness and ductility in the interior structure is also useful.

Although our invention has been described by reference to a few specific illustrations, it is not intended that the invention be considered to be limited to the forms shown. For an exact definition of the limits upon our invention, reference may be made to the appended claims.

We claim:

1. Ammunition for an industrial stud driving tool comprising a primed cartridge; a propellant powder in said cartridge; an elastically deformable cup-shaped sabot secured in the mouth of said cartridge, the open mouth of the sabot being exposed; and a stud having a head received and resiliently retained within said cup-shaped sabot, said cup-shaped sabot defining a stud head receiving pocket adapted to be elastically deformed by the insertion of a stud head therein, said pocket being so shaped that portions of the walls of said pocket having a transverse inside dimension greater than the outside dimensions of the stud head alternate with portions of the walls of said pocket which prior to elastic deformation by the insertion of the head of a stud have a transverse inside dimension less than the outside dimensions of the head of the stud.

2. In ammunition for an industrial stud driving tool including a primed cartridge having a charge of propellant powder therein, the combination comprising a cup-shaped sabot secured in the mouth of said cartridge with the open mouth of the sabot exposed; and a stud having a generally cylindrical head received within said cup-shaped sabot, said cup-shaped sabot being formed to define a generally right circular cylindrical stud receiving recess of greater inside diameter than the diameter of the cylindrical head of the stud which at one or more locations deviates from right circular form to provide stud gripping portions which are mutually tangent to an inscribed circle of less diameter than the diameter of the cylindrical head of the stud.

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3. The combination described in claim 2, said deviations from right circular form being defined by localized increases in the thickness of the portion of the sabot surrounding said recess.

4. In ammunition for an industrial stud driving tool including a primed cartridge having a charge of propellant powder therein, the combination comprising a cup-shaped sabot of tough resilient material secured in the mouth of said cartridge with the mouth of said sabot exposed; and a stud having a head received and resiliently retained within said cup-shaped sabot, said cup-shaped sabot being formed to define a generally right circular cylindrical stud receiving recess which at one or more locations deviates from right circular form by localized increases in thickness of the material forming the portion of the sabot surrounding said recess, said localized increases in thickness comprising circumferentially spaced flats extending chord-wise across portions of the wall of said generally right circular cylindrical recess.

5. The combination described in claim 4, the major diameter of the head of any of the series of studs being less than the major diameter of said cylindrical recess and greater than the diameter of an inscribed circle tangent to each of said flats.

6. A driving sabot for interchangeable use with any one of a series of industrial studs having generally cylindrical heads, said sabot comprising a right circular cylindrical body of tough resilient plastic material having formed therein a generally right circular cylindrical recess of larger inside diameter than the diameter of said heads, said recess being formed to define one or more deviations from right circular form which are mutually tangent to an inscribed circle of less diameter than the diameter of said heads.

7. A sabot as described in claim 6, said deviations comprising circumferentially spaced flats extending chord-wise between portions of the wall of said recess of right circular cylindrical conformation.

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