Nov. 12, 1946. W. S. CONNER ET AL 2,411,026

FIRING RANGE BUTT

Filed Feb. 21, 1944 3 Sheets-Sheet 1

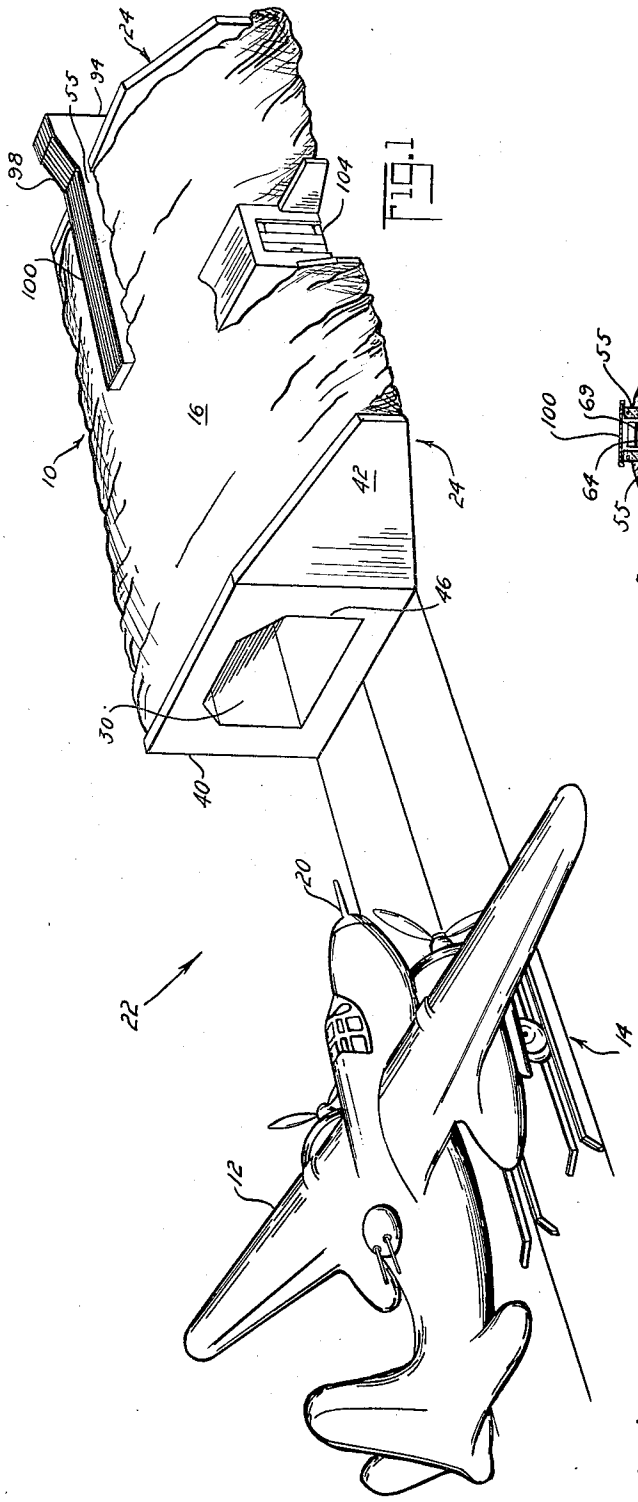


FIG. 1

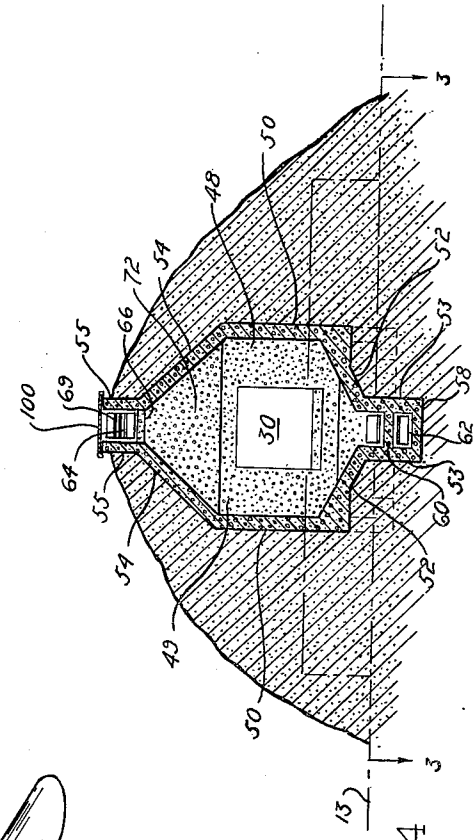


FIG. 4

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FIRING RANGE BUTT

Filed Feb. 21, 1944 3 Sheets-Sheet 2

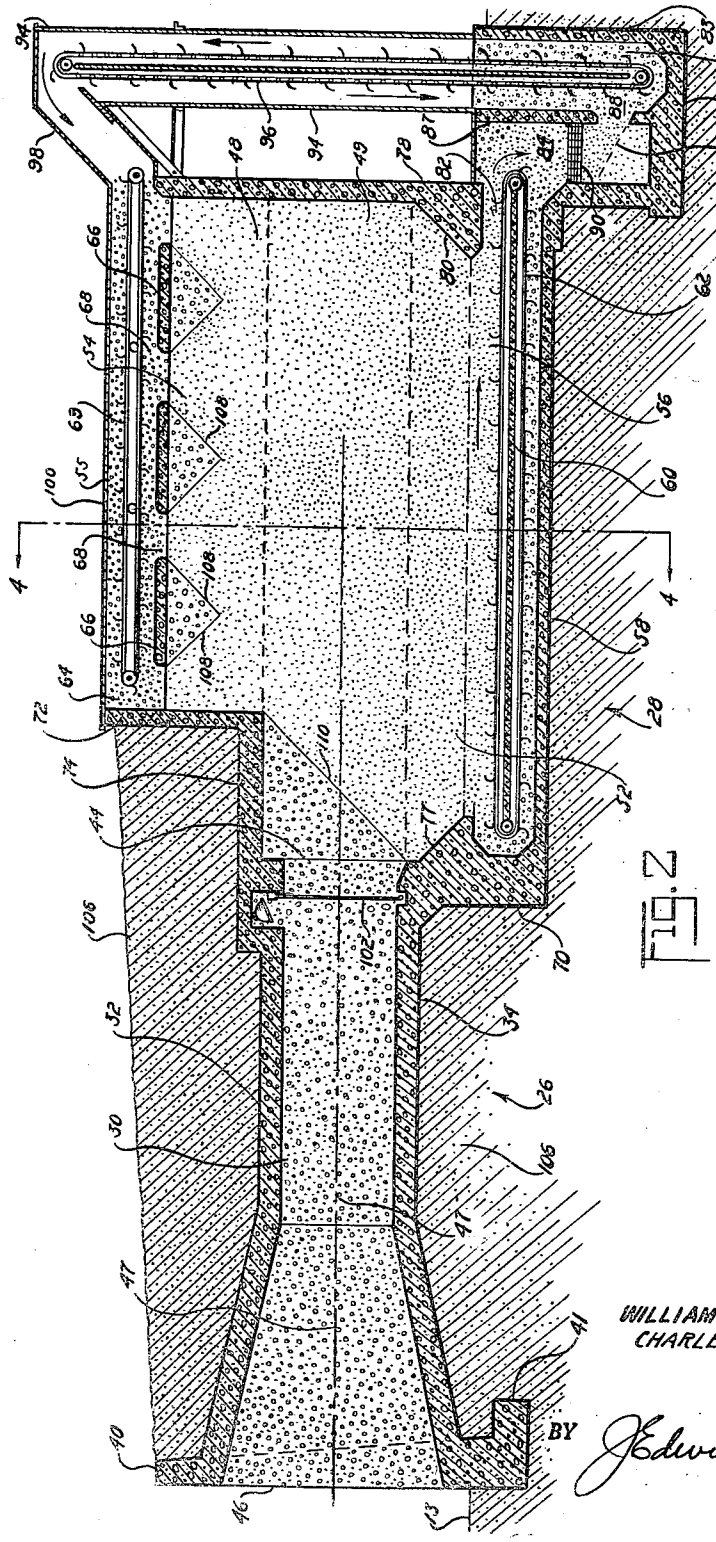


Fig. 2

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FIRING RANGE BUTT

Filed Feb. 21, 1944 3 Sheets-Sheet 3

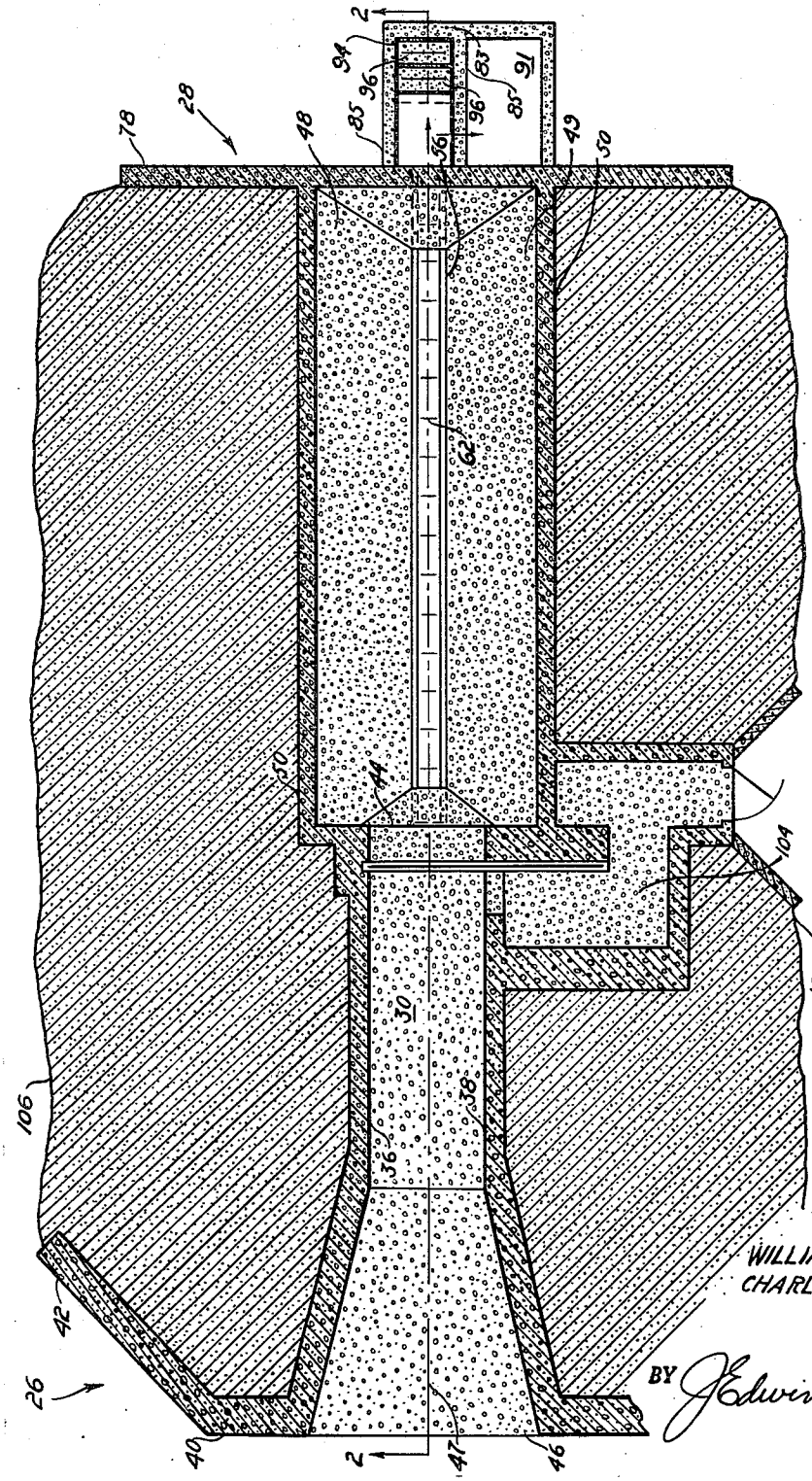


FIG. 7

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FIRING RANGE BUTT

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11 Claims. (Cl. 273—102.4)

1

This invention relates to firing range butts, and particularly to butts for firing ranges used in testing airplanes for withstanding recoil stresses resulting from firing a gun mounted on the plane.

In carrying on these tests the plane is placed within a short distance of the butt in position for firing the gun into the butt. This distance may be as small as 25 feet. The butts of present construction are masses of earth, either naturally mounded or retained by walls of wooden cribbing or concrete or of other construction. When larger projectiles from the heavier guns now mounted on airplanes are fired successively into these butts at short range, the earlier fired projectiles make a bore in the loose earth or one devoid of earth through which later fired projectiles pass at high velocity. The later fired projectiles strike the earlier fired projectiles at the inner end of this bore in the earth of the butt and ricochet from them through the rearward surfaces of the butt, sometimes passing completely through the butt and causing damage to property, or injury or death to persons.

It is an object of this invention to provide a butt which will stop all of the projectiles fired successively thereinto, and which will be reconditioned after any one shot for the safe reception of the next shot.

It is another object of the invention to provide a butt of movable, and preferably continuously movable, mass of sand or other granular projectile-receiving material to prevent one projectile striking another earlier fired projectile.

It is still another object to provide means for readily separating and removing the projectiles from the sand.

Another object is the reconditioning of the sand by the ready removal of the finer particles thereof.

A further object is to provide a butt of sand or similar material provided with an entrance tunnel of concrete or other rigid material which will deflect improperly aimed projectiles into the sand, and particularly to protect the conveying equipment, if such be provided for moving the sand for the purpose outlined above.

In the drawings, which illustrate one embodiment of the invention,

Figure 1 is a perspective view of a firing range utilizing a butt embodying the invention.

Figure 2 is a central longitudinal section of the butt shown in Figure 1.

Figure 3 is a horizontal section taken along the line 3—3 of Figure 4, with no sand shown in the sand chamber.

2

Figure 4 is a transverse section taken along the line 4—4 of Figure 2, with no sand shown in the sand chamber.

As shown in Figure 1, at one end of a firing range 22 is a firing butt 10, and at the other end thereof an airplane emplacement 14. Testing projectiles are fired into the butt from a gun 20 mounted on an airplane 12 which is stationed for the test at any given distance from the butt by moving the airplane toward the butt until a nose or other ground wheel of the airplane contacts a ground abutment (not visible in the drawing).

The butt 10 comprises a wall structure 24 of concrete having a forward portion 26 (see Figures 2 and 3) and a rear portion 28 integrally joined to the forward portion. The forward portion has a bottom wall 34, two side walls 36, 38 and a top wall 32 enclosing a tunnel or passage 30 through which projectiles are fired from the gun 20. The tunnel walls diverge outwardly at their forward portions to afford a front opening 46 for receiving the projectiles even though aimed at a considerable angle to the direct line of fire 47 into the butt. The tunnel is sized and shaped to deflect inwardly projectiles so improperly aimed as to strike the tunnel walls at any station between the tunnel front opening 46 and the tunnel rear opening 44, though the wall taking the impact of the projectile may be damaged thereby.

The tunnel walls are supported at their ends by the front vertical wall 40 and by a front vertical end wall 70 of the rear concrete structure 28. The wall 40 rests upon a concrete footing 41 and has two earth retaining wings 42. The tunnel wall structure is supported intermediate its ends by the central lower portion of the earth fill 106, other continuous portions of which are banked against the side walls 36 and 38, the top wall 32, front wall 40, and end wall 70 and also against walls of the rear concrete structure 28 to form a mound 16 as best shown in Figure 1.

The rear concrete structure 28 encloses a sand chamber 48 filled with a mass 49 of sand or other like material characterized by relatively movable granules. The structure 48 includes two side walls 50.

At the lower edges of the side walls 50 are inwardly and downwardly converging inclined lower walls 52 terminating in two narrowly spaced parallel vertical walls 53, which, with a bottom wall 58, define a channel shaped trough or chamber 56 for housing an endless flight conveyor 62 disposed below and generally parallel to the line of fire 47. A horizontal partition concrete wall

60 separates the upper and lower runs of this conveyor. At the upper edges of the side walls 50 are inwardly and upwardly converging inclined upper walls 54 terminating in two narrowly spaced parallel vertical walls 55 which, with a concrete bottom wall or floor 66 joining their lower edges, define a channel shaped chamber or trough 64 for housing an upper endless flight conveyor 69 disposed above and parallel to the line of fire 47. The bottom wall 66 is formed with transverse openings 68.

At the front end of the sand chamber 48 is the vertical wall 70 extending upward slightly above the top level of the opening 44, a rearwardly extending horizontal wall 74 joined to the upper edge of wall 70 and a vertical wall 72 extending upward from the rear edge of wall 74 to the level of the upper edges of conveyor side walls 55. A rear end wall 78 extends from a level substantially below the ground level 13 to, and is joined with, the concrete conveyor floor 66. The lower conveyor floor 58 is joined at its rear end with the end wall 78. The end walls 70 and 78 are formed with sloping faces 77 and 80 respectively to cooperate with the walls 52 in guiding the sand 49 to the conveyor 62 without lodgment of any portion of the mass of sand.

The rear concrete structure 28 also has a relatively deeply disposed bottom wall 81, rear wall 83, side walls 85 and a vertical transverse partition wall 87, which with the lower portion of the wall 78 define a sand receiving chamber 84 and the lower portion of an elevator chamber 86. Sand is removed by conveyor 62 from the sand chamber 48 through a horizontally slotted opening 82 in the wall 78 into the receiving chamber 84 where it drops onto the transversely sloping coarse meshed screen 90 which separates the projectiles from the sand. The projectiles roll into a pit 91 from which they may be periodically removed.

A lower fine meshed longitudinally inclined screen 92 receives the sand, allowing the finer granules to fall therethrough and causing the coarser granules to slide through an opening 88 through the wall 87 into the bottom of the elevator chamber 86. These finer granules made so by the impact of the projectiles and the operation of the conveying equipment, are relatively less effective in absorbing the kinetic energy of the projectiles and bringing them to a stop.

The upper portion of elevator chamber 86 is an elongated sheet metal box 94 connected at its upper end with an enclosed sheet metal sand chute 98 which leads downward from the upper end of the box 94 to the rear end of the conveyor chamber 64. A metal cover plate 100 protects the conveyor 69 in the chamber 64. An elevating conveyor 96 lifts sand received from screen 92 to the chute 98.

A target 102 may be slidably moved from target chamber 104 into place across the opening 44. The earth fill 106 is banked beneath and at the sides of the rear concrete structure 28, leaving the cover plate 100 exposed for removal to gain access to the mechanical equipment of the sand chamber 48. The tunnel 30, by deflecting inwardly improperly aimed projectiles, protects the upper and lower conveyor equipment from injury.

The operation of the firing butt is, for the most part, apparent from the foregoing description. After an airplane 12 has been placed in position for test firing, the gun 20 is aimed at the target 102 and one or more projectiles are fired therefrom into the sand 49. The conveyors 62 and 69 and the elevator 96 are continuously operated while the butt is in use. Removal of the sand from the bottom of the sand chamber 48 by the lower conveyor 62 causes the sand in the chamber to descend slowly, carrying with it the projectiles embedded therein, no two of which will therefore be at the same level. Thus it becomes impossible for one projectile to strike an earlier fired projectile and ricochet therefrom to cause damage to the butt or to surrounding property or injury to persons in the neighborhood. The sand carrying with it the projectiles is discharged into the separating chamber 84 and the projectiles and fine sand removed therefrom in the manner already described. The sand free of projectiles is returned by the elevator 96 to the upper end of the chute 98, down which it moves, to be engaged by the upper conveyor 69 and moved horizontally and longitudinally of the sand chamber to be dropped through opening 68 to the top surface of the sand mass in the chamber 48.

The lines 108 indicate the inclined upper surface contour of the sand mass in the sand chamber below the upper conveyor floor 66 and the line 110 indicates the surface contour of the sand mass from the lower edge of the wall 72 to the lower edge of the target opening 44. The offset spacing of the wall 72 to the rear of the target opening prevents any of the sand flowing into the target opening and interfering with the placement and removal of the target. It also prevents the permanent lodgment of any sand in the rear end of the tunnel 30. Should sand thus project into the tunnel and hold one or more projectiles, these projectiles would remain stationary in the sand mass and not be removed from the sand chamber, creating the possibility of other projectiles striking them and being ricochetted from the butt.

While one embodiment of this invention has been described and illustrated it is apparent that the invention is not limited to this one embodiment. Its scope is defined in the following claims.

We claim:

1. In a butt for a firing range, the combination of: a retaining wall structure; a mass of relatively movable granules confined by said structure, said structure being formed with an opening to permit projectiles to be fired into said mass without striking said structure; and means mounted within said structure outside of the path of said projectiles for moving said mass transversely of the path of the projectiles through said mass.

2. In a butt for a firing range, the combination of: retaining walls providing a chamber for holding a mass of relatively movable granules, said walls having an opening for the admission of the fired projectiles; and means for cyclically moving said mass of granules in said chamber to provide a stream of granules constantly moving transversely of the path of the projectiles entering the chamber.

3. In a butt for a firing range, the combination of: upright retaining walls providing a chamber for holding a mass of relatively movable granules, said walls having an opening thereinto through one of said walls for the admission of the fired projectiles and said opening being arranged to prevent loss of granules therethrough from said mass; and means for moving a mass of granules in said chamber downward through said chamber by removing granules from a lower level below the

path of the projectiles in the chamber and returning the granules to an upper level of the chamber above said path.

4. In a butt for a firing range, the combination of: upright retaining walls providing a chamber for holding a mass of relatively movable granules, said chamber having an opening thereinto through one of said walls for the admission of the fired projectiles and said opening being so constructed and arranged to prevent loss of granules therethrough from said mass; and means including conveyor means capable of continuous operation for moving a mass of granules in said chamber downward through said chamber by removing granules from a lower level below the path of the projectiles in the chamber and returning the granules to an upper level of the chamber above said path.

5. The combination defined in claim 4, and in addition thereto; a separator disposed along said moving means for separating and removing projectiles from the granules.

6. The combination defined in claim 4 in which said moving means comprises a first horizontal conveyor at said lower level, a receiving chamber at the discharge end of said horizontal conveyor, an elevating conveyor from said receiving chamber to a level at least as high as said upper level, and a second horizontal conveyor to receive the granules from the upper end of said elevating conveyor and discharge the granules at said upper level, and in addition thereto; a separating screen in said receiving chamber across the path of the granules and arranged in an inclined plane for separating the projectiles from the granules and discharging them by gravity laterally of the receiving chamber.

7. The combination defined in claim 4 in which said moving means comprises a first horizontal conveyor at said lower level, a receiving chamber at the discharge end of said horizontal conveyor, an elevating conveyor from said receiving chamber to a level at least as high as said upper level and a second horizontal conveyor to receive the granules from the upper end of said elevating conveyor and discharge the granules at said upper level, and in which said walls are of cement concrete and include two side walls generally longitudinally parallel to the projectile path, the said side walls below the level of the projectile path being flared inwardly and downwardly terminating in relatively narrowly spaced vertical walls, housing said first horizontal conveyor, and above said path level being flared inwardly and upwardly terminating in relatively narrowly spaced vertical walls, housing said second horizontal conveyor, and in addition thereto; a mass of earthy material banked against the exterior of said side walls.

8. In a butt for a firing range, the combination of: a retaining wall structure providing a laterally enclosed space and having an opening through a vertical wall thereof for the passage of projectiles into said space; a second wall structure integrally joined to said first wall structure and providing at least the top and side walls of a tunnel communicating with said opening and also for the passage of said projectiles, at least the inner end portion of said tunnel having substantially the cross section of said opening; a mass of relatively movable granules held to form within said space; means for cyclically moving said mass of granules to provide a stream of granules constantly moving transversely of the interior end portion of said tunnel; and a mass of earthy material banked against the exterior of at least the side walls of said wall structures.

9. The combination defined in claim 8 in which said retaining wall above said opening is horizontally offset interiorly of said space to prevent granules entering said opening; and in addition thereto a target mounted in said opening.

10. The combination defined in claim 8, and in addition thereto; means for moving said mass of granules downward through said chamber by removing granules from a lower level below the path of the projectiles in the chamber and returning said granules to the top surface level of said mass, comprising mechanical equipment disposed at least in part in transverse alignment with said mass with reference to the longitudinal lines of said passage and above and below said opening.

11. The combination defined in claim 4 in which said moving means comprises a first horizontal conveyor at said lower level, a receiving chamber at the discharge end of said horizontal conveyor, an elevating conveyor from said receiving chamber to a level at least as high as said upper level, and a second horizontal conveyor to receive the granules from the upper end of said elevating conveyor and discharge the granules at said upper level, and in addition thereto; a separating screen in said receiving chamber across the path of the granules and arranged in an inclined plane for separating the projectiles from the granules and discharging them by gravity laterally of the receiving chamber; and a second separating screen in said receiving chamber across the path of said granules for separating relatively smaller granules from the relatively larger granules.

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