TECHNICAL DESCRIPTION OF NASA SCREW-GUN

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INTRODUCTION:

The purpose of this technical description is to provide an explanation of the workings of the "NASA SCREW-GUN" developed by Mr. Robert L. Fullerton. The reader is referred to illustration number one attached to this technical description. Mr. Fullerton is also the inventor of the Fullerton Zip-Nut; a device showing great promise for the NASA Space Shuttle Program. The Zip-Nut has already been used by NASA as the "SHARE stop-removal-tool" on STS 29.

HISTORY:

In 1981 Mr. Robert L. Fullerton invented the "Zip Nut". The patented Zip Nut allows a bolt to be freely slid straight into the nut without turning the bolt or the nut. When the bolt is inserted the desired depth a short quarter to one-half turn tightens the bolt and nut in the same manner as a conventional fastner. An added feature of the Zip Nut is that it does not require that the bolt and nut be perfectly aligned (on a longitudinal axis) before the fastners can be threaded or securely tightened. This feature is very important for robotic applications where precision alignment is a problem. With the invention of the Zip Nut it was only a matter of time until the evolutionary design needs of outer space prompted the need for a "Screw-Gun" to place the Zip Nuts and bolts into position. It is this expressed need that we propose to address with the NASA SCREW-GUN.

OBJECTIVE:

The functional design objective for the NASA SCREW-GUN is to provide the astronauts with an efficient, single-handed means of attaching nuts and bolts while in a nearly weightless environment. The design problem emanates from the following criteria:

1. The astronauts time while in outer space is valued at $50,000 to $90,000 per hour. Therefore, time consuming manual operations, complex hand manuevers and simple routine activities must be severely reduced.

2. The astronauts must have a means of generating small amounts of torque and applying that torque to a series of fasteners without the torque "counter-reacting" upon the astronaut and thereby moving the astronaut.

3. The astronauts require a means of attaching and tightening fasteners in such a manner as to eliminate or severely reduce the fatique factor for the astronaut.

4. The NASA SCREW-GUN must be operable with one hand only and must be reversible to serve as a tightening and loosening device for the fasteners.

5. Materials utilized in the construction of the NASA SCREW-GUN and it's components must be compatible with a space environment.

6. The NASA SCREW-GUN must be able to store the nuts and bolts as it is removing them or tightening them in an effort to avoid the loose fasteners from floating away. The astronaut should not have to remove them from the gun until the storage cavity is filled.

7. The NASA SCREW-GUN must be designed as a modular system to change from one size of fasteners to another size in an convenient manner. Additionally, the NASA SCREW-GUN shall be designed as a modular system to change from bolts to nuts and back in a simple manner.

8. It is necessary for the NASA SCREW-GUN to be able to reach behind or around a strut or fastened component and "grasp" the nut while at the same time inserting or unthreading the bolt. This feature will allow the astronaut to assemble/disassemble bolts and nuts. The nut must not be allowed to "escape" or float away.

9. Weight of the NASA SCREW-GUN must as light as possible in order to reduce motion fatique of the astronaut and because of the high costs associated with lifting each and every pound of weight into outer space.

DIMENSIONS/WEIGHT:

The NASA SCREW-GUN will be approximately 12 to 14 inches long, approximately 6 inches high and approximately 3 inches wide. It will weigh less than three pounds (unloaded).

OPERATION:

Bolts and nuts are adhesively bonded together in a staight-line with an adhesive or plastic designed to "break-away". This line of adhesively bonded bolts becomes a "clip" that is inserted into the NASA SCREW-GUN much like a magazine of cartridges is inserted into a conventional semi-automatic rifle.

The "breech-block" secures a bolt, separates the bolt from the other bolts, lowers the bolt into the "chamber" of the barrel, and drops below the barrel. The barrel is "rifled" with straight hexagonal internal cross-section; much like a conventional socket wrench. The barrel receives the boltand secures the bolt by the head of the bolt riding in the internal socket shaped barrel. The chamber (breech) of the barrel is chamfered from a round internal shape to that of the hexagonal internal shape so as to provide a smooth transition for the bolt head.

The barrel is rotated by means of an electric (rechargeable) battery powered motor located in the handle of the NASA SCREW-GUN. This rotary motion provides the torque necessary to turn the bolt or nut thereby tighening the fasteners. Counter-rotation of the NASA SCREW-GUN is provided by "fore-arm hook" which rests perpendicularly to the forearm of the astronaut and counter acts the torque of the rotating barrel and fastener.

Activation of the NASA SCREW-GUN is provided by pulling a "trigger" type switch which controls a rheostatic electrical circuit. The more the trigger is pulled, the more torque that is applied to the bolt or nut. At maximum torque a clutch mechanism restrains the NASA SCREW-GUN from applying any more torque.

Reversing the rotation of the NASA SCREW-GUN is accomplished by flipping a lever on the side of the gun with the thumb of the hand used to pull the trigger. Thus maintaining single hand operation characteristics while tightening or removing bolts or nuts.

A "backing-arm" is used to reach around behind a fastened component or strut. This backing-arm will be firmly attached (though easily removeable)to the front of the NASA SCREW-GUN. The backing-arm will be utilized to grasp the nut in such a manner that the screw-gun can insert the bolt and tightened it in place. This feature allows the astronaut to assemble/disassemble nuts and bolts using one hand.

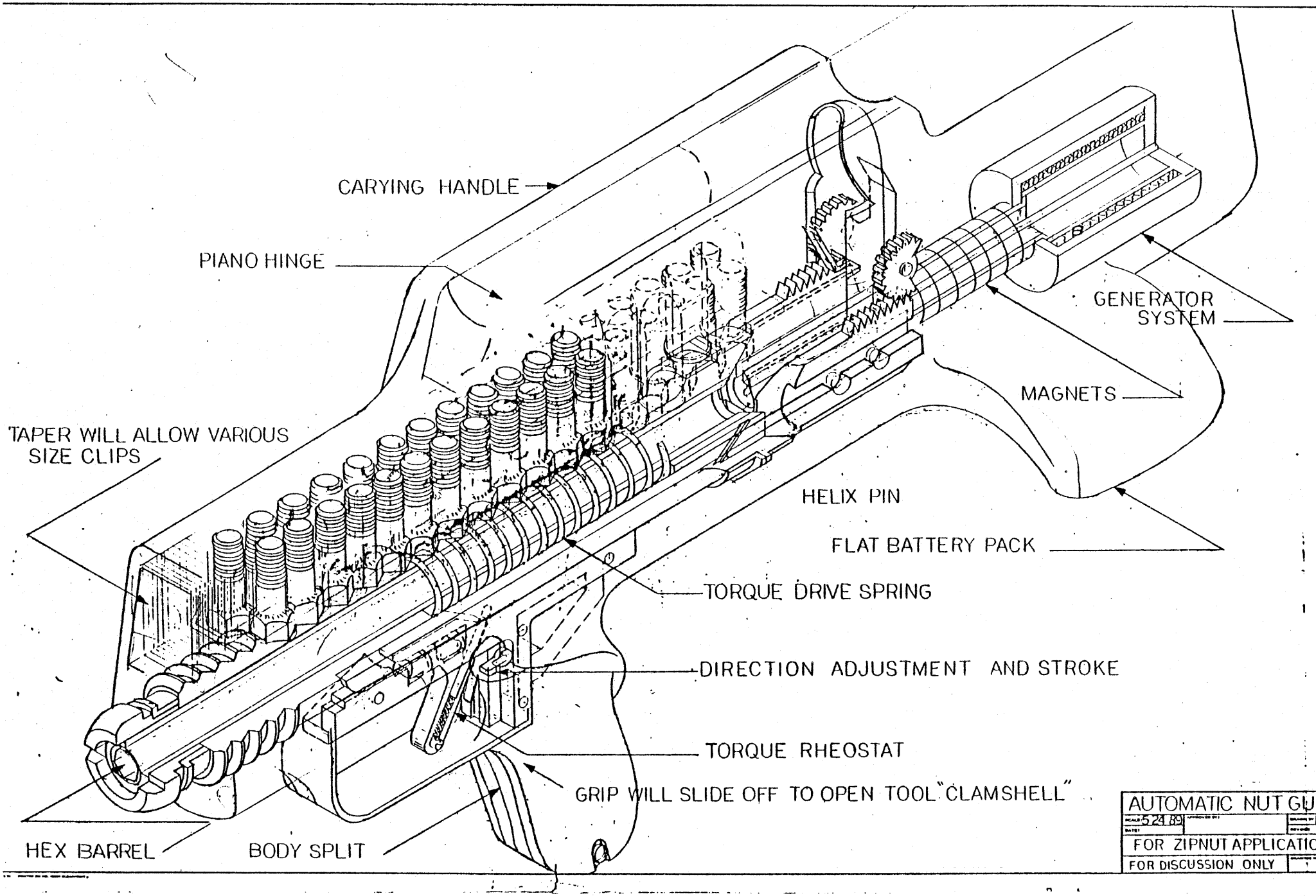
The top of the NASA SCREW-GUN is hinged to allow for insertion/removal of bolt "cartridge" clips, nut "cartridge" clips, changing the barrel/breech block assembly, or for removing accumulated nuts/bolts (when dissassembling fasteners). This feature allows easier maintenance, modular changeovers, and cleaning.

MATERIALS:

It is envisioned that the NASA SCREW-GUN will be fabricated out of the following materials:

1. Handle/fore-grip/fore-arm hook --Engineered plastic
2. Barrel/breech block/bolt guides----------Aluminum
3. Motor----------Copper & steel
4. Trigger mechanism/backing-arm ------Stainless steel
5. Battery-pack----------Unknown

Prototypes of the NASA SCREW-GUN will be fabricated of aluminium and/or stainless steel.


CARYING HANDLE
PIANO HINGE
GENERATOR SYSTEM
MAGNETS
TAPER WILL ALLOW VARIOUS SIZE CLIPS
HELIX PIN
FLAT BATTERY PACK
TORQUE DRIVE SPRING
DIRECTION ADJUSTMENT AND STROKE
TORQUE RHEOSTAT
GRIP WILL SLIDE OFF TO OPEN TOOL "CLAMSHELL"
HEX BARREL
BODY SPLIT
AUTOMATIC NUT GUN
5.24.89
FOR ZIPNUT APPLICATIO
FOR DISCUSSION ONLY