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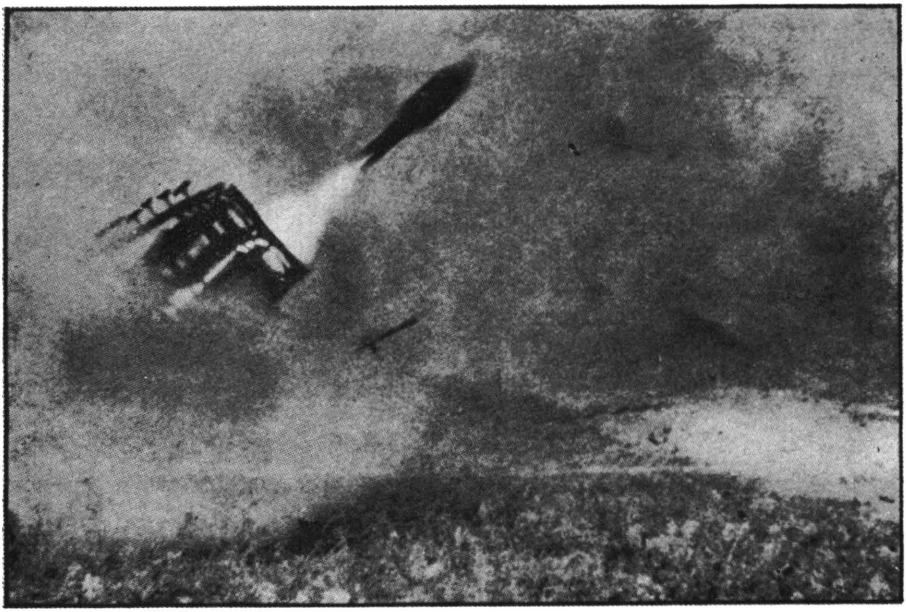

GIANT ROCKET OR HOAX? Do the Nazis actually possess gigantic rocket projectiles, as this German photo purports to show, or are threats of long range bombardment of England mere propaganda to bolster morale ?

THE AMERICAN ROCKET SOCIETY

was founded to aid in the scientific and engineering development of jet propulsion and its application to communication and transportation. Three types of membership are offered: **Active**, for experimenters and others with suitable training; **Associate**, for those wishing to aid in research and publication of results, and **Junior**, for High School Students and others under 18. For information regarding membership, write to the Secretary, American Rocket Society, 130 West 42nd Street, New York City.

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NOTES AND NEWS

It is no longer a secret that the British, in the early stages of the Battle of Britain, lacked sufficient numbers of anti-aircraft guns for defense of their island. As a cheap and more quickly produced substitute they set up thousands of rocket batteries to combat the onslaught of the Luftwaffe. Such rocket flak is not as accurate as cannon fire but did serve well to keep the Nazis at respectful altitudes, reducing the accuracy of their bombing. The Germans, their defenses now overtaxed and much of their anti-aircraft gun production blasted, are now adopting the same tactic—of late an increasing proportion of the flak being encountered by Allied bombers is in the form of jet propelled shells. To attain altitudes of 25,000 feet step rockets are resorted to, and crews tell of seeing a rocket burst far below only to release a second, smaller projectile which zooms up at the formations. The Nazis are also using various forms of rockets and pyrotechnics to dazzle and confuse the tense raiders.

First news of United States use of aircraft rocket projectiles comes from the South Pacific War theater which discloses that "airborne rockets" have been fired from Marine torpedo bombers against Japanese shipping at Rabaul and other concentration points of enemy naval forces. Further details will be reported when available.

Anglo-American Thermal Jet Plane

Designer Whittle Overcame Inertia, Discouragement

Similar to all proponants of jet propulsion, in the days before the present war, the man who is today Wing Commander F. Whittle endured years of discouragement before finally seeing his thermal jet motor recognized, adopted, developed and finally hailed as a large step forward in the science of aircraft flight. One of his original supporters, Flight Lt. W. P. Johnson, has revealed that Whittle trudged from industrialist to industrialist vainly trying to obtain backing to build and test his design.

While studying at Cambridge University, Whittle imbued four of his friends, Johnson, G. Lees, J. C. B. Tinling and R. D. Williams, with his enthusiasm and between them managed to raise enough money to form a small company which they named "Power Jets, Ltd.". The initial flight of an airplane equipped with a Whittle engine took place in England during 1939.* Following further research an order was received from the British Air Ministery and the first official flight made in May, 1941 by the late Flight Lt. P. E. G. Sayer, chief test pilot of the Gloucester Aircraft Company, who had supplied the airframe. During July, 1941 details of the engine design were made available to the U. S. Army Air Forces and since that date development of the engine has been a joint English-American project. The original engine was delivered to the General Electric Company for study and production.

Within three months not only had a number of these engines been built and ground tested in the United States, but Bell Aircraft Company had constructed an experimental test airplane to accommodate two of the units. The first American flight was made on October 1, 1942 by Robert M. Stanley, Bell's chief test pilot. Since that time numerous Army officers have flown the "Squirt" as the ship is named. In addition to this airplane numerous other companies, both here and in England, have constructed, or plan to construct, aircraft powered with the Whittle or similar thermal jet power plants. It need hardly be added that the Ger-

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Commander Frank Whittle — Designer of first Allied thermal-jet aircraft engine.

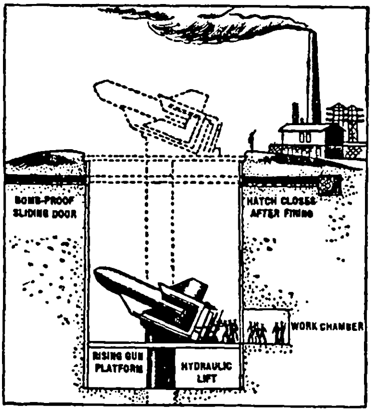
The Nazi Rocket Threat

Giant Projectiles Awaiting Invasion

by Roy Healy

Facts: Along the French coast are a multitude of concrete and steel pits, erected by the Nazis to serve as the launching points for giant, long-range rocket projectiles whose weight at firing will exceed 50 tons. This tremendous self-propelled bomb is no secret weapon—the Allied intelligence staffs long ago ferreted out details of its construction and Nazi plans for its use. In fact concentrated bombing of the launching points — the correctly designated "rocket gun coast" of France—and also the attacks on factories known to be producing components of this fearsome missile made clear to the German general staff, many months ago, that the giant rocket was no secret. Since this realization the Nazi high command has freely boasted to the world of the giant rocket and its tremendous potentialities for retaliation upon England for the bombing of German cities. In order to confuse allied opinion and thought the Nazis have released, and caused to be circulated through neutral countries, much misinformation about the giant rocket. So many conflicting and exaggerated stories have been circulated that a number of U. S. "military experts" have been led into denying not only the existence of the long-range rocket projectile but even the feasibility of such a weapon.

The huge projectile utilizes a rocket booster section to launch itself from the pit and attain its initial speeds of approximately 700 m. p. h. Thereafter the booster is jettisoned and the rocket is propelled by thermal airjet units until a velocity estimated at over 2000 m.p.h. is reached. The total range of the rocket is approximately 150 miles. As the distance from the Pas de Calais area to London is about 90 miles the Nazis have undoubtedly spread their launching pits over some depth to prevent all of them falling into Allied hands if a successful invasion of the coastal strip is accomplished. Launching takes place from a slope within the pit, the projectile is believed to be placed upon a car which rides up a steel track as the rocket booster is fired. This method is similar to that used by Von Opel in his pioneer rocket flight of 1929 and is widely used to-



SCEPTICISM—Most American newspapers believe giant rocket story a fake, yet publish artists depictions such as this from New York's World-Telegram.

day to launch aircraft from various warships. The car may have auxiliary rocket power units installed to aid the projectile in gathering speed. Jettisoning of the rocket booster, after its charge has been exhausted, is probably accomplished by explosive charges within hollow attachment lugs, a favorite German method.

The thermal - air - jet units are thought to be of the Leduc type, utilizing the dynamic pressure of flight to build up compression in a duct prior to the injection and ignition of the fuel used to impart thermal energy and high velocity to the exhaust jet. This type unit is simplicity itself, eliminating the need for mechanical compressors and their driving units, but can be used only where a high velocity is attained before the unit is called upon to deliver power. The liquid fuel used would probably be a crude oil as the compression attainable would probably not exceed three atmospheres. The air jet units are probably arranged in a circle around the body of the great rocket. It is possible that the projectile, as finally used, may be fitted with stub wings, for increased range, and have the air jet units installed in these.

Four big problems remain to be settled—what destructive effect will the projectile possess on impact, what accuracy can be obtained and how many of them do the Nazis possess and what is the production rate? Many stories have come out of the terrific destructive ability of the rocket—disregarding these it should be equivalent to at least several of the new British 12,000 lb. bombs. It is unthinkable that the Nazis expect to effectively use this weapon unless some form of directional control is contained within the rocket. At a distance of 150 miles the natural dispersion of the rocket projectile would be certainly not less than 1.5 miles, far too inaccurate for effective use. In all probability the Nazis are counting on some form of electronic control. As remote radio control is subject to jamming a number of frequencies would be used with a switchover should the one being used be jammed. It is possible that high altitude control planes might be stationed along the intended flight path and control of the projectiles passed from one to the next as the rockets blazed through the sky.

ROCKET LAUNCHER—Comparison of this photo with that on cover and that on next page will prove cover picture is of small, short range projectile, and not of giant rocket. Nazis are withholding all photos of "secret weapon".

It is not expected that the weapon will be used, except for a few trial firings, until the actual invasion of continent is attempted. At that time London, which is a psychological target rather than a military target, may be subjected to limited bombing by these rocket projectiles but the bulk of what the Nazis have available at that historic moment will be directed at any concentration of invasion craft in the Channel, and also at fighter plane bases within its range. In addition batteries of smaller rocket projectiles, as the 32 cm. rocket shown in accompanying photos, will open fire on landing craft approaching the French Coast.

32 CM Rocket Projectile — Captured Nazi shell, in launcher crate, being examined by U. S. soldiers in Italy.

Years of research were necessary for the development of such a colossal rocket bomb, and even today it is being improved. Across the waters of Lake Constance come the roarings of more and more powerful rocket motors being tested by the Nazis. There can be no doubt that an undertaking of this scope has utilized some of the best brains of Germany. The problems of production in quantity, probably is the only reason the long range rocket has not been already fired at Allied targets.

What steps are being taken to counteract this threat? Look at your newspaper today—intense continued bombing of the launching pits goes on daily, some of the deep penetration raids into Germany are aimed at plants producing the great rockets, transportation needed for conveying the projectiles to the pits is being disorganized by constant raids. The English people have been told by Churchill not to become panicky if rocket raids are staged by the desperate, but ingenious, Nazi high command.

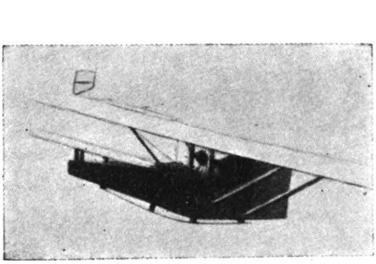
Rocket Power For Gliders

Auxiliary Units Seen Helpful In Warfare

by Cedric Giles

The German occupation of the Lowlands, during 1940, demonstrated to the world the first specialized military use of the glider. The capture of Crete, in which airborne troops played a most important part in the Nazi victory, followed by the more recent invasion of Sicily and Italy by the Allies firmly established the troop glider as an important weapon for swift, silent attack. Combat gliders are now widely used for transporting troops and supplies to landing fields where powered aircraft cannot land. Glider troops possess the advantage of landing together with all weapons on hand and ready to go into immediate action. Paratroops do not enjoy this advantage.

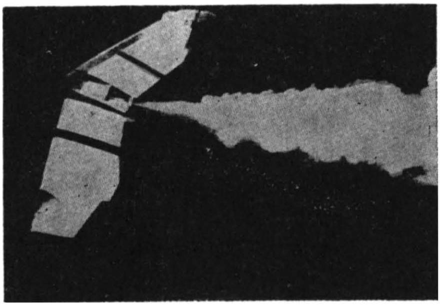
Despite the marked success of the glider for vertical envelopment it is still not as useful as it could be made. The installation of a number of small rocket power units would make the glider self-propelling whenever the need for evasive or tactical maneuvers arose. They would be extremely useful during take-off, approach and landing of the glider.



First Rocket Glider. Stamer piloting German "Duck" during 1928 flight.

Unpowered aircraft, lacking conventional engines and propeller, can be designed to a higher degree of aerodynamic efficiency than the airplane. When small aircraft engines, with propellers, are added to gliders some of this efficiency is lost, due to increased drag, whereas the addition of jet engines could be accomplished with very small change in the aerodynamic characteristics of the glider. A number of jet units would be less vulnerable to enemy gunfire than one or two conventional aircraft engines added to the glider.

For mass movement of airborne troops the large glider, towed by aircraft, is of course, far superior to small high performance sailplane type aircraft. If, instead of the customary procedure of using any available bomber or transport to tow the glider trains, a special "locomotive" plane was specifically designed for this purpose a greater degree of efficiency could be obtained. As an airplane can pull more than it can lift, by towing loaded gliders a towplane can transport more than double its normal load. Generally the towplane's speed is decreased about 25% when towing a heavily loaded glider. Flight at normal towing speeds leaves the glider convoy extremely vulnerable to enemy fighter attack and a protective covering of fighters is usually necessary during the greater part of the flight.



Model Planes — Rocket propelled, were numerous during 1930's.

Take-off

The usual glider take-off procedure consists of a multimotor airplane pulling one or more gliders down the runway behind it. In another method the airplane soars low over the airfield and snatches the glider into the air by catching a drag hook into the glider's elastic nylon tow rope. Installation of jet propulsors on the gliders to function during the take-off would appreciably lessen the stress on both the towplane and the gliders. In fact, installation of rocket motors on the towplane itself for additional power during the take-off run would seem called for to deliver a huge power boost, enabling a heavier load to be taken off the ground. If desired, once the train is in flight, the jet units could be dropped by parachute for further usage.

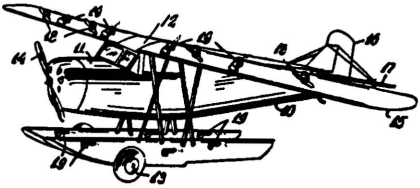
An interesting possibility lies in the proposal to catapult the glider into the air by some mechanical arrangement, and aided by skillful use of thermal currents in the air as well as short burning rocket charges, to join the tow in flight.

Flight

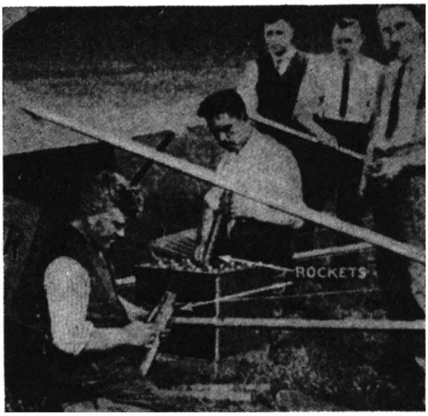
During the usual towed flight, with the aerial train flying above the towplane in fan-like formation, a great strain is placed on the glider pilots due to the necessity of continually watching the towplane, towropes and other gliders to prevent overriding or collision with another glider. With jet units mounted on each glider emergency maneuvering in flight would be facilitated and less stress placed on the pilot's skill. At a reasonable distance from the objective the gliders could be disengaged from the towplane and glide the remainder of the way using jet power to flatten their glide.

Landing

Considered expendable, most combat gliders are designed for use only once during an assault flight. Although their landing speed is comparatively low many gliders, having no wheeled landing gear, are severely damaged in belly landings because of lack of control during this function. The use of rocket charges, fitted on the glider in such a manner as to fire forward, would brake the sliding, grinding landing run considerably and might suffice to minimize damage. To clear any dangerous obstacle, seen at the last moment as



American Patent — By Berkowitz (1931) suggested numerous small rocket units for emergency power supply.



Powder Rocket charges being prepared for loading in magazine of Opel Rocket Glider.

is often the case when landing in wooded terrain, the stern rocket units could be used to deliver sufficient power to overcome this hazard. It might be possible for the glider, when emptied of its load of troops and equipment, to use rocket power to take-off again, under certain conditions, and move back to a safer point.

Attack Technique

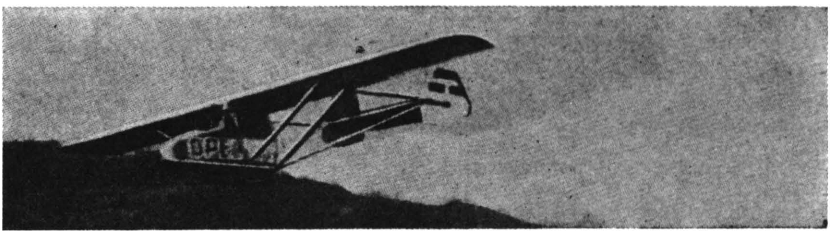
The adaption of amphibious gliders, for island warfare, is at present under consideration. Instead of being towed behind the carrier based bombers of a task force the gliders might be rocket launched from small vessels, or directly from the water if smooth enough seas permit, and fly to the vicinity of their objective. By using aerial "landing boats" coming down behind the prepared beach defenses the usual dangerous island landing tactics might be made unnecessary.

Glider kites are being used by some convoy vessels in lieu of the usual barrage balloons. If this glider was made large enough to carry a man it would serve not only to spot hostile aircraft, warships and submarines, but when equipped with a rapid-fire weapon might discourage attack by hostile aircraft. Should it be made sufficiently large to carry bombs, or a small torpedo, the ship-towed glider might slip its line and attack any enemy submarine in the vicinity of the convoy.

Utilizing a heavily armored glider as a "flying pillbox" to land behind enemy lines has been suggested. Unfortunately the heavier the glider becomes the more wing surface it needs for flight or its range will become too limited for use.

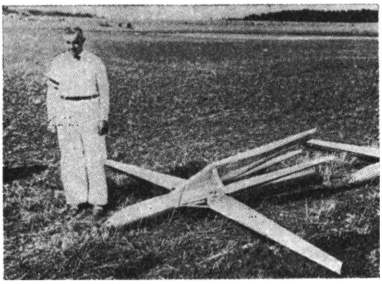
Composite Aircraft

In addition to possible uses for transporting troops, the glider has been suggested as a means of increasing the flight duration of night



Take-off of Opel Glider during 1929 flight.

fighters. In the novel "slipwing" fighter a speedy night patrol fighter is attached underneath a large glider-type biplane. The glider assembly carries enough fuel to supply the engine of the fighter, for powering the composite aircraft, to allow patrolling the sky for several hours. Upon approach of enemy aircraft the fighter would detach itself from the glider and go into action. The upper component of the combination, relieved of the weight of the fighter, would be glided to its base, by its pilot, assisted by light but powerful jet motors.



Tiling's Folding-Wing Mail Rockets. Later evolved into Rocket-Glider Bombs.

A variation of this composite aircraft to assist take-off of heavily loaded airplanes has been proposed, comprising an airplane and a pickaback glider. The wings of the detachable mounted light-weight glider are so proportioned as to provide high lifting force to the composite aircraft. When fitted with jet units the auxiliary glider may also deliver extra power to the airplane in take-off and, on being released from the airplane, may utilize jet power for facilitating landing.

Experiments with Rocket Gliders

The above expressed ideas are certainly not visionary as experiments with rocket powered gliders have been carried on spasmodically for many years. The first manned rocket glider flight on record took place in the Rhon Mountains of Germany on June 11, 1928. During a meet of the Rhon-Rossiten Gesellschaft, a German gliding society, a small glider, piloted by Friedrich Stamer, was launched into the air by the usual shock cord method. Upon reaching the desired altitude Stamer fired two rocket charges attached to the fuselage of the glider and covered a distance of slightly over a mile in one minute. The black powder charges used weighed 44 lbs. apiece, no information seems available as to the reaction developed. Later experiments with this glider resulted in burning of the fabric of the fuselage and the tests were terminated.

Fritz von Opel made the first successful flight, during which an aircraft took off, flew and landed under rocket power, on September 30, 1929 at an airfield near Frankfort, Germany. The specially built glider took-off from a small car propelled along a 50 foot track by three rocket charges weighing 10 pounds apiece. Leaving the car at a velocity of over 65 m.p.h. the 500 pound glider sailed through the air, belching flame and smoke from its 16 charges arranged in 4 rows directly behind the cockpit. In the 75 seconds of flight the plane flew 1¼ miles at a 50 foot altitude, attaining a maximum speed of 95 miles per hour.

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Spear Shaped Weather Rocket

Annular Nozzle Feature of Design

by Constantin P. Lent

The device shown in the accompanying photograph and drawings is a rocket intended for weather research, its function would be to carry recording instruments to high altitudes for long range weather forecasting. Because of its peculiar shape it might be called a "spear" or "arrow" design. The arrangement of tanks and motor are intended to attain the maximum of flight stability without recourse to directional control apparatus.

As shown in Fig. 1 two tanks, which will contain the propellants, are connected to the rocket motor located in the head of the rocket. To facilitate safe return to earth the tail section contains a parachute of ample size.

Tank **A** might contain the charge of gasoline, Tank **B** the charge of oxygen necessary for combustion. Forced by pressure of an inert gas into the combustion chamber **E** through piping **F** and **G** the gasoline enters through openings **H** and the oxygen through jets into the chamber. The propellants are mixed, in the vicinity of **K** in a circle around the central core **L.** A conventional spark plug M, energized by a small battery not shown, is used to ignite the mixture. The nozzle **D**, termed a "balance nozzle", is of skirt shaped design and is located concentrically to the body of the rocket proper.

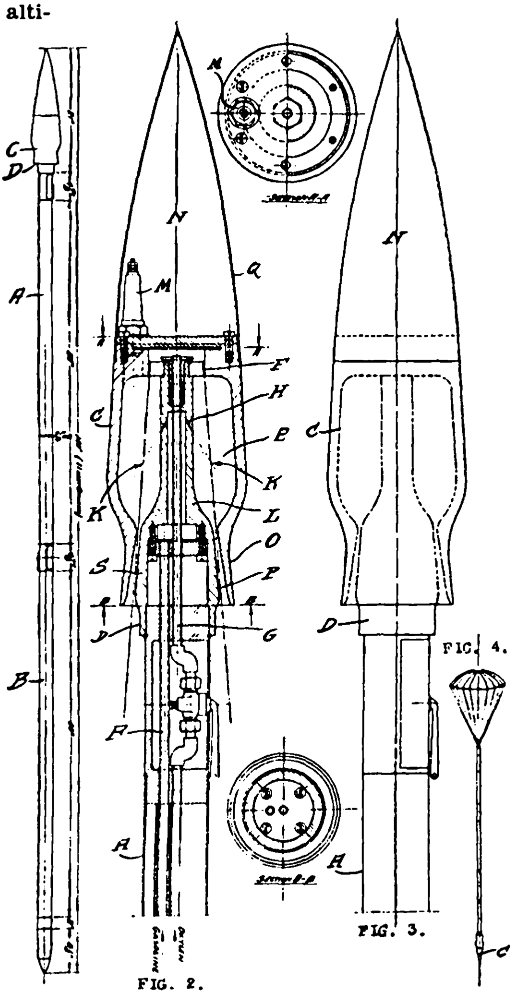
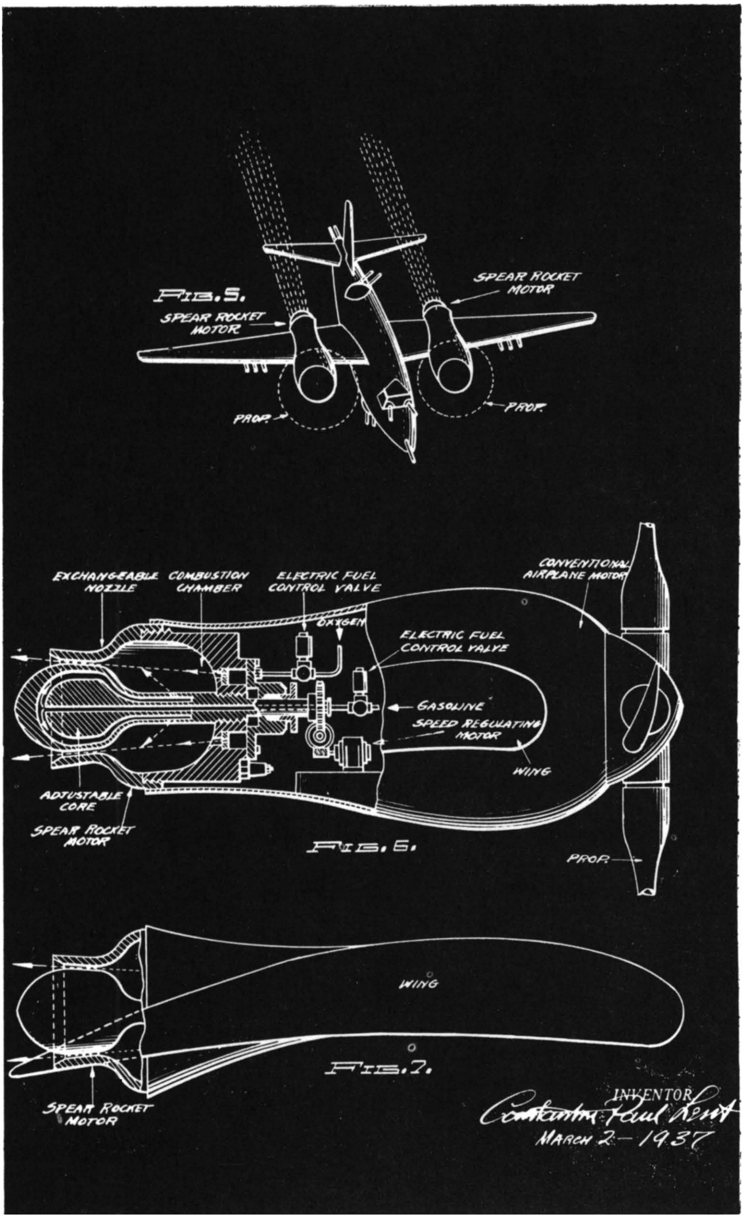
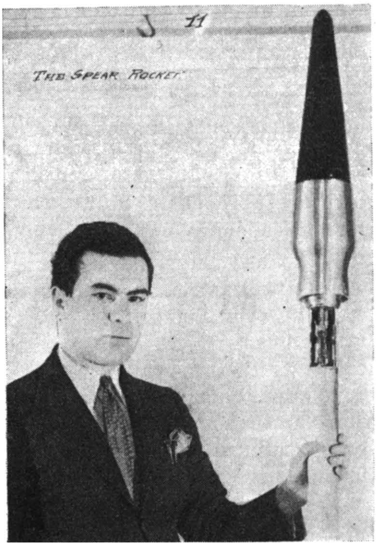


FIG. 1. FIG. 2. FIG. 3. FIG. 4.



Rocket motors of similar design could be utilized as aircraft auxiliary power plants.



Mr. Lent and upper portion of his novel rocket.

The resultant gases of combustion exhaust to the atmosphere through the nozzle orifice **P**, the latter being formed by the outside skirt-shaped portion **O** of the rocket motor **C** and the lower portion **S** of the core **L**. Departing from conventional practice in rocket motors the nozzle of the spear rocket has an annular throat and thus can be made of much greater diameter than the usual axial orifice. In this particular design the inside diameter of the nozzle is 2½", while the orifice opening is only 1/32" in width. Due to the exhaust gases passing over a larger wall surface there is less tendency of the nozzle to be corroded by the high speed and temperature of the exhaust, while the greater area of the outer nozzle walls provides more effective cooling to the motor nozzle.

Although primarily designed as a weather rocket—to carry instruments under the space **N** in the head—its novel construction is easily adaptable for use in aircraft propulsion. In Fig. 5 a possible installation of two of these motors in the nacelles of a twin-engined airplane is shown. In Fig. 6 one may see that the inside adjustable core is held within the combustion chamber in such a manner that by turning the core by means of a small speed regulating motor movement of the core axially in and out of the combustion chamber will be obtained, resulting in variation of the annular nozzle opening through which the jet gases exhaust. By changing the cross sectional area of the orifice control is exercised over the volume of the gases expelled in the jet and as a consequence regulates the thrust of the motor, providing the pilot of the airplane with a means of control. Under these conditions the delivery of propellants to the motor is automatically and proportionately varied by a pair of electrically operated valves controlling the flow into the chamber. Direct attachment of the spear motor to the airplane wing is shown diagramatically in Fig. 7.

(Continued from Page 3)

man Air Force has at least two models of thermal jet fighters in an advanced stage of development.

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* For a report of this flight, and a comparison of Whittle and Campini designs, see **Astronautics** for November 1939. For a detailed description of these, and other thermal jet motors, see Gohlke's comprehensive article on "Thermal-Air-Jet Propulsion" in **Astronautics** for May 1942.

Hs 293 ROCKET GLIDER BOMB

USE AGAINST ALLIED SHIPPING REVEALED.

The Luftwaffe is making use of two types of jet propelled bombs—one of these, of which not much has been revealed, is a rocket accelerated one ton bomb said to possess terrific penetrative effect. The other, of which details have recently been revealed, is a rocket powered glider bomb launched from under the wings of large German aircraft and directed toward its target by radio control. This devilish device, resembling a stubby winged torpedo, is known as the Hs 293 and is produced by the Henshel works, a minor producer of Nazi aircraft.

With a wing span of approximately 12 feet the 8 foot missile is equipped with conventional tail surfaces actuated by control from the parent plane. Underneath the bomb is a cylinder, approximately 1½ feet in diameter and 6 feet in length, which contains the rocket motor assembly and fuels. The nature of the liquid fuels has not yet been disclosed.

Ships landing Allied troops at Salerno, at Anzio and at other Italian points have been subjected to repeated, and in some cases successful attacks, by these glider bombs carried by and launched from large Nazi bombers such as the Do 217, the Fw 200, the He 111, and the He 177, which usually carry one of the glider bombs under each wing. Numerous attacks on shipping off the Spanish and Southern coast of France testifies to the widening use of this weapon by the Nazis.

Flying parallel to, but out of gun range of the target, the parent plane releases the glider bomb and sets off its rocket propellant unit. The aircraft then slows down allowing the rocket glider to spurt ahead under its rocket power. When the glider bomb is some distance out ahead of the bomber it is turned around through 90° and headed for its target. Because of its relatively small cross section the glider bomb presents a difficult target for the ship's defensive fire as it comes diving down at speeds of 375 m.p.h. Used only to impart a high initial velocity the rocket charge is exhausted in a short period of time and the glider, released from a considerable height, is followed to the target by means of a small green or red tracer charge in the tail. This allows the bombardier to correct his aim if he is off, or if the target takes evasive action.

The explosive head of the bomb is thought to be equivalent to that of a 1000 lb. bomb. By use of the rocket glider bomb the Nazis claim to have sunk the Italian battleship Roma and to have seriously damaged a number of others when the Italian Navy fled from Taranto. Since that time they have undoubtedly been used against British and American warships in the Mediterranean. The advantages of this method of bombing are obvious and it is not to be doubted that further use of it will be seen in the future against targets other than ships.

Electronic Spacial Rocket

Possibilities and Difficulties Outlined

by Robert L. Sternberg

(It has been some time since ASTRONAUTICS has published any writing on interplanetary travel problems. Due to the press of more mundane developments, such as war rockets, thermal jet planes, jet booster motors for bomber take-off, we have at times lost sight of the greatest possibility offered by rocket power—that delightful prospect of escaping from this frowsy, bloody, unhappy planet to some bright new world. Ed.)

For many years writers have dreamed of interplanetary rocket flights, but few of these have seriously treated the two outstanding obstacles to realization of this most interesting possibility. The greatest problem concerns the tremendous power output necessary for long periods of flight and the second difficulty is the huge amounts of fuel which the rocket must carry to develop the required power.

The majority of rocket motor designers plan to obtain their power from the ejection of a molecular gas at velocities of several thousand feet per second. With a rocket of any practical size and having a jet velocity of, say, 10,000 feet per second and a mass of flow per second small enough to enable its fuel to last through the major portion of a flight, say, to Mars, would develop so small a reaction as to probably never leave the ground, much less leave the earth's gravitational field.

To eliminate this inherent obstacle the stcp rocket system has been often suggested. This requires starting out with a mountainous lower step and would be very cumbersome. It is the belief of the writer that a more efficient method exists.

Instead of discussing a jet of molecular gas we may consider a stream of electrically charged particles accelerated by electrostatic fields and guided by magnetic fields. Such a rocket motor would be similar in principle to a cathode ray oscilloscope, although on a much magnified scale. One might separate hydrogen gas into electrons and protons and then discharge the negative particles through one tube and the positive particles through another, and accelerate each stream by electrostatic fields. The partial vacuum, necessary for production of ionized gas in the manner in which canal rays are produced in a cathode ray tube, could be maintained while within the earth's atmosphere by means of aspirator pumps. In outer space, of course, the problem would solve itself.

Utilizing this principle we could produce a jet velocity of several thousand miles per second, instead of feet per second, and consequently our mass rate of flow, and our fuel supply would not need be a major problem. Visualizing a light weight rocket, with the required energy supply, propelled by ionized hydrogen the writer has calculated that a round trip to Mars might be made with an expenditure of about 8 to 10% cf its mass. The jet of ionized hydrogen nuclei would have velocities comparable to those of the canal rays in modern cathode ray equipment.

For practical purposes the duration of this hypothetical flight must be limited to weeks or months at most and this time limitation sets the order of the power requirements, if we multiply this by the inverse of the efficiency of our machine we will have the actual power development required. With such tremendous jet velocities our efficiency would be low, according to oft stated theories. The practicability of such an electronic rocket depends on the development of a relatively light weight power source to produce the electrical forces needed. The high velocity jet, itself, has already been realized on a small scale in oscilloscope and cathode ray experiments. Undoubtedly many years of research will be necessary before such a high speed jet of protons and electrons, or of sufficient magnitude, will be commercially possible, nonetheless even today research into atomic energy has progressed sufficiently far to warrant optimism on the part of those who envision electronically driven spacial rocket craft.

(Continued from Page 10)

In Italy Ettore Cattaneo tried to emulate Opel in a flight during 1931 at Milan. In one successful test the glider covered a distance of nearly a mile in 30 seconds of flight. A number of other experimenters made similar flights in the years following, among them being the German pilot, Hans Espenlaub, who narrowly escaped death on his initial flight when the rocket charges set fire to his glider. First flight in the U. S. is credited to W. G. Swan, who during 1931 made a demonstration flight at Atlantic City, N. J. Using 12 rockets, each producing about 50 lbs thrust for 1 second, Swan took off at about 33 m.p.h. and reached a height of about 200 feet.

From these initial crude tests with low-powered black powder charges development of jet propulsion has progressed to the point where heavy German bombers make use of solid fuel charges for auxiliary power during the take-off run, and undoubtedly all other powers are in possession of powerful rocket charges which could easily be adopted for use with gliders in some of the ways suggested above.

ASTRONAUTICS, official publication of the American Rocket Society, is devoted to the scientific and engineering development of the rocket and its application to problems of research and technology. Published by the American Rocket Society, 130 W. 42nd St., New York City. Subscriptions with Associate Membership, $3 per year. **Editor: Roy Healy.**