GOODYEAR
AIRCRAFT

NEW AIR TRANSPORT SYSTEM

FOR

HEAVY BULKY CARGO

(Advance Copy)

By

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Foreword

One of the most perplexing problems facing the Aerospace Industry today is the transportation of large boosters from the manufacturer's plant to the launch site. With the immense complexes that are required in terms of manpower and facilities to support our space program, it can truly be said that the transportation problem is one of national character. It is, therefore, indicated that a coordinated solution to the problem is required. It is further indicated that the present availability of the Navy's latest airship equipment could provide an immediate as well as a long range solution at comparatively low cost.

Introduction

As boosters increased in size from the relative small Vanguard to the larger sizes of Thor, Titan and Atlas, it became apparent that booster transportation would require particular attention. This increase in booster size required the development of special transporters and handling equipment to facilitate booster movement. Granted that special attention was required, however, it was still possible to move anywhere in the nation by using conventional transport methods.

As space technology advanced, the size of boosters also continued to grow until the twenty-foot diameter stages of the Saturn C-1 vehicle soon became design fact. Concurrent with the design advance of these larger stages, Industry and Government program planners intensified their efforts concerning the logistics of booster movement. A number of companies deeply concerned with the problem performed independent transport studies some of which included very detailed route surveys. It became apparent that the growth limitation of the existing transport facilities was rapidly being approached.

Perhaps the whole transport problem is now graphically illustrated in the following three figures. (Fig. 1, 2, and 3.) The first figure depicts the relative decrease in freedom of booster movement based on the increase in booster size. The second one is a representation of the increase in booster movement requirement based on estimated launch data. The third figure, which is the key to the whole problem, illustrates the national distribution of aerospace capability relative to existing launch sites.

With a recognition of the problem, a number of inquiries were directed to the Goodyear Aircraft Corp. in regard to the transport of boosters by Airship. As a result, several independent design studies were performed. However, each of these study efforts were directed toward the solution of a specific booster transportation problem.

About two years ago, under contract with the Air Force, Goodyear Aircraft conducted a comprehensive study relative to the development of an Airship Booster Transportation System (ABTS). This system, which comprised airships specifically designed for the mission, was intended to handle the transporting of all large boosters through 1970. Needless to say, programs have been accelerated in the meantime.

Sometime after completion of the study for the Air Force, supplementary information was compiled relative to ttansporting the Saturn S-II and S-IV stages. Concurrent with this event, a revision to Navy AEW requirements indicated that the ZPG-3W Airships and support equipment could be made available. This meant that a booster transport system was possible through the modification of existing hardware, capable of moving the Saturn S-II and S-IV boosters at comparatively low cost.

Discussion

In an attempt to study the requirements of a national booster transportation system, it appeared judicious to break the study into three periods of prime concern: (Fig. 4)

1. Initial needs
2. Intermediate needs
3. Future needs

In order to fulfill the initial requirements for a booster transportation system, it appeared that we should concentrate on providing immediate implementation, utilizing a vehicle of low initial costs, which could also operate at a low cost. To fully satisfy our present needs, this vehicle should be capable of operating from the factory area directly to the launch site with very high reliability being, therefore, capable of extremely short take-offs and landings. It should be able to travel from any point to any other point in the United States, so as to have national coverage and should be capable of carrying payloads of up to 20,000 pounds. A vehicle fulfilling these requirements could handle the immediate booster transportation problems for most launch vehicles now under consideration.

In the near future, we would need an intermediate transportation system, which would fulfill all of the needs mentioned above as well as to carry payloads up to approximately 90,000 pounds. When one considers future requirements then naturally everything we need today would be supplemented by a VTOL capability, a world-wide coverage, and a capability of carrying payloads up to 600,000 pounds.

A review of present airship capabilities shows us that we could satisfy our initial requirements by modifying existing airships. (Fig. 5) We could handle the intermediate requirements by modifying and enlarging existing airships or by building new airships. However, for future requirements, it appears that we would have to design and build a new air transport system, as it would not be practical to try to expand our existing equipment into these performance requirements.

The recent announcement by the Navy that they were decommissioning their new ZPG-3W airships, created interest in the possible review of these configurations to see if they could fulfill any of the requirements, particularly for immediate application. This resulted in some rather interesting conclusions in load carrying capabilities, cost, and availability dates. In the first place, it appeared that a very simple modification of a ZPG-3W airship was possible. It would consist primarily of adding an outrigger extension, resulting in the lowering of the landing gear such that this airship could then carry payloads up to 20 feet in diameter and up to 20,000 pounds. This would fulfill the initial requirements previously mentioned.

In attempting to fulfill the intermediate requirement, it appeared that two basic modifications could be considered.

1. Combine two existing ZPG-3W's into a single dynamic lift configuration

   or

2. Combine two enlarged ZPG-3W's into a single dynamic lift configuration.

From a preliminary study of the intermediate requirements and a brief analysis of several means of combining the envelopes of two airships to make one dynamic lift configuration, it appeared that the latter of the two suggestions above would probably be the most acceptable. However, this will be discussed a little later.

One of the major considerations in this program of modification of airships was that enough equipment would be available to make two of any ship under consideration. It was felt that for any reliable air transport system, a backup vehicle would always be necessary. This would provide for any contingencies such as emergency maintenance, the ability to handle unscheduled or unplanned trips, etc.

Figure 6 is an artist's concept of a ZPG-3W, modified to carry a payload about 20 feet in diameter similar to the S-IV stage of Saturn. It would be carried externally, probably in a pressurized fabric container, filled with dry air or helium and maintained by the airship's existing pressure system.

As illustrated in Fig. 7 with the extended landing gears, this airship could be handled on the ground with its payload in place exactly the same as the present ZPG-3W airships. The existing mobile mooring mast would have an extension to handle the additional height. Ground handling would be done by the existing Mules, which are special 4-wheel drive vehicles containing a constant tension winch designed particularly for this application. Every modification to the airship would be in the most economical manner possible since it is not anticipated that this is to be a high performance vehicle but rather that it is to perform the function of a giant aerial truck, with high reliability, on time deliveries, from any one spot in the country to any other spot, carrying the payload so gently that it never experiences as much as 1/2 "g".

An example of a typical mission would indicate the type of performance that could be expected from this modified airship. In the first place, it would be able to take-off with its payload in still air over a 50-foot obstacle in 2300 feet. As shown in Fig. 8, if a small airfield were not adjacent to the manufacturing site, this could be performed out of the parking lot of most large aerospace firms. The airship does not require a fancy hard surface runway, but merely any reasonably flat area. In this particular case the illustration indicates that a heavy take-off is being performed where the airship employs a take-off run and operates much like an airplane, assuming an angle of attack and creating dynamic lift as soon as sufficient forward velocity is obtained. In the event that a lighter payload is carried or a wind exists, it is possible to take-off in even less space.

A typical flight with an S-IV booster might be from Los Angeles to Sacramento - the test area. Another might be from Los Angeles to Cape Canaveral and even a third might be from Huntsville to the Cape. In all of these cases, the airship could carry the S-IV payload non-stop from one site to the other. To get a feel of how long an average trip from Los Angeles to the Cape might take, one might visualize a pick-up late Friday afternoon from Los Angeles and the airship waiting at the Cape Monday morning when work begins. In other words, a trip of approximately that length would take less than two days.

In the event that a long trip is envisioned or severe headwinds are encountered, the airship could refuel in flight and still perform a non-stop mission. In-flight refueling of an airship is a standard procedure, developed by the Navy in which the airship picks up fuel from a truck or boat without the requirement to land. On a cross-country trip, even though refueling might not be required to perform its mission, the airship might pickup water or fuel enroute or when it arrived at its destination just so as to increase its weight to replace that loss by fuel consumption and, hence, perform a standard heavy landing. A "heavy" airship lands much like an airplane, performing a flare-out and utilizing its reversible pitch propellers to bring it to a stop. While it stands on its tricycle gear, the Mules pick up the handling lines and maneuver the airship to the portable mast. While at the portable mast, the payload is lowered by internal winches to the ground and trucked away.

Fig. 9 shows a map of the United States with the routes mentioned indicated in black. The dotted line shows a recent cross country flight made by a ZPG-2 airship, which is only about 2/3 as large as the 3W vehicle recommended as the initial air transporter.

For the intermediate requirement, two ZPG-3W's can be made into a single twin type of airship which provides a large space for the booster between the two hulls. Figure 10 shows an artist's concept of this configuration. In Fig. 11 a cross sectional illustration of the catenary arrangement in the envelopes shows how the two envelopes are actually made into one utilizing the standard catenary attachment method of fabrication. With the larger payload in the center and the two cars on each side, this weight distribution over the top of the twin envelope becomes very practical. It is also quite apparent that very large payloads can be carried here without interfering with normal ground handling operations. Even larger payloads than those shown could be handled by a mere increase in landing gear height.

The twin airship would be flown from one car and the controls of both would be slaved together electrically. An emergency crew, however, would stand by in the second car and a passageway is provided in the lower part of the envelope to permit crew members to transfer from one car to the other. In this way, it is possible to utilize all of the existing control systems in the airships as they were originally designed - each car handling its own envelope.

From preliminary estimates, it appears that most of the time two engines would be adequate for cruise, however, four engines will probably be used for increased take-off performance, excess air supply for the ballonets and for safety and reliability.

For handling the twin airship on the ground, we would use the conventional mast system with the mast modified as shown in Fig. 12. As can be seen, this mast could be fitted with three heads so that it could handle either the twin arrangement or a conventional single-hulled airship. Both configurations could still weather vane into the wind and preliminary checks have shown that this modification can be provided on the existing mast.

In the interest of simplicity and reliability and to maintain the costs as low as possible, every attempt in this study so far has been to incorporate as much existing equipment as possible and to utilize standardized techniques which have proven to be successful. It appears that this is possible utilizing existing airships and ground support equipment for both the initial requirements and the intermediate requirements described earlier. If one, however, desires to fulfill the future requirements, a new air transport system must be developed, although many of the techniques employed in the initial and intermediate system will yield valuable experience for this new system. Additional features can also be provided since the sizes required dictate entirely new vehicles.

A new air transporter could have some very interesting features. It could carry large and heavy payloads and it could have a VTOL capability so that it could take off and land in any field of its size. For this preliminary study, we arbitrarily assumed that the new air transporter would be built in an existing air dock. We, therefore, limited the size accordingly. It appears that no technological breakthrough would be required, and, therefore, an early availability would be possible with the new air transporter system. Consideration was also given to a requirement for a minimum amount of ground handling gear and if necessary an unlimited range could be provided if a nuclear powerplant were utilized.

As shown in Fig. 13, the vehicle would fit in the large dock at Akron, Ohio. This illustration shows the external ballonets, which would be deflated while the ship is in the hangar and would be inflated and remain so always whenever it is outside of the hangar. To give some idea of size, the vehicle itself be shown comparatively in Fig. 16. Here the major factors of payload capability, time necessary to develop the configurations, and cost are shown. The modified 3W, which could carry the S-IV stage of Saturn could be put into operating condition in nine months for less than $1-1/2 Million. If one were to compare the twin 3W with a new airship of the same volume - 3 million cubic feet, it is readily apparent that the twin version can be in operation in almost half the time and for about one-third the money required for a new airship. An enlarged twin compared to a new airship of the same volume - 4 million cubic feet, could be provided in about 2/3 the time and approximately 1/3 the money. Even the chemical version of the new air transporter capable of carrying 600,000 pounds could be provided in three years and a nuclear version about a year later. It is quite apparent that even though a twin airship configuration may carry a slightly lower payload than a new airship, the tremendous savings in cost and lead time indicate that consideration of these configurations, utilizing existing Navy equipment, would be well worthwhile.

A brief summary of the performance characteristics is shown in Fig. 17. Here the three categories -- initial requirements, intermediate requirements and future requirements-are portrayed by a modified 3W, the enlarged twin and the air transporter. As can readily be seen, an altitude of 5,000 feet and a maximum velocity of 75 knots were considered for all vehicles. From an analysis of the possible routes that these air transporters might take, it appeared that this altitude would be satisfactory and with this maximum speed the Navy's experience with this type of vehicle indicated that schedules could be met. The cruise speed was increased slightly from 45 to 55 knots for the air transporter and, of course, the range was increased from 800 nautical miles to 3,000 miles if chemical fuel was used so that global routes could be considered. In the event that nuclear fuel is used, this range would become indefinite. The ranges for the two smaller ships of 800 nautical miles were based on a payload of 20,000 and 90,000, respectively. Of course, this does not include aerial refueling by which non-stop flights from one end of the country to the other, even with these payloads, could be made.

An LTA vehicle, as any HTA vehicle, becomes less expensive to operate per hour of flight time if it has high utilization. Fig. 18 shows that at a reasonable utilization of somewhere between 20 to 40% the airship has the very low operating cost of approximately $100 to $200 per hour. Doubling the size of the vehicle does not double the operating cost and it, therefore, appears to be quite reasonable to consider very large air transporters to carry the large boosters planned.

One of the most important considerations of this study is the early availability of this equipment primarily due to the fact that the major components are available now and relatively straightforward modifications can be made to provide the country with a new air transport capability. A review of the boosters contemplated indicates that the three vehicle types portrayed in Fig. 19 should be considered for implementation immediately. This would provide the ability to air transport 20,000 pound payloads in nine months, 90,000 pound payloads or larger in 20 months and 600,000 pound payloads in three to four years. It is also recommended that a study program be conducted before the enlarged twin or the air transporter work is initiated so as to determine the best values for these configurations. Such a study would show where it would be most economical to stop increasing the vehicle size for one configuration and where the next one should start. It might well be that it would be advantageous to design a slightly larger twin than the one shown here at this time.

Recommendations

In summary, it is recommended that a ZPG-3W airship be put into immediate service in order to provide the capability of air transporting boosters up to the S-4 size stage. It is also recommended that a study be conducted to determine the size and specific modifications required for the twin ZPG-3Ws to handle the intermediate air transport problem. Even though the very large boosters are not yet available, it is also recommended that an immediate study be made of the specific requirements and preliminary design of an air transporter system to handle future large payloads. If this work is started now then by the time the boosters are ready to be used, the means for handling them will be available.

This ability to carry large, heavy payloads at reasonable speeds from manufacturing site to test or launch site, without the dimensional problems associated with land transport or the time problems associated with water transport, is vitally needed in the United States. Recent demonstrations with this type of LTA vehicle has shown it to be the most reliable all weather transport concept known today. The ability to carry a payload over long distances in relatively short periods of time at ultra-light "g" loadings provides delivery at the destination in substantially the same condition as of the point of departure - an inestimable value.

Projected breakdown shows space-launch schedule through 1975

Customer or Prime Agency	Utilization	Project or Code Name	Mission or Operation	Present Booster Stage	Upper Stage Designation	Booster Thrust In 1000 Lbs	Payload Weight In Lbs	Orbit Altitude In Miles	60	61	62	63	64	65	66	67	68	69	70	Estimated Flights Between 1971-75	Estimated Total Number of Flights Between 1965-75
									Estimated Number of Planned Flights per Year												
NASA	Meteorology	TIROS	Weather Observation Satellite	THOR	ABLE DELTA	165	270	450	2	3	-	-	-	-	-	-	-	-	-	—	—
NASA	Meteorology	NIMBUS	Same Advanced Version	THOR	AGENA B	165	600-700	700	-	1	2	2	2	1	1	2	3	1	1	30	39
NASA	Meteorology	AEROS	24-hr Satellite Weather Observation	ATLAS	CENTAUR	390	—	23,000	-	-	-	-	2	2	2	2	4	2	2	15	29
NASA	Observation	OAO	Orbiting Astronomical Observatory	ATLAS	AGENA B	390	3500	550	-	-	-	1	2	3	3	3	3	3	3	15	33
NASA	Observation	OGO	Orbiting Geophysical Observatory	ATLAS THOR	AGENA B (EGO) AGENA B (POGO) CENTAUR	390 165	1000 1500	150-60,000 170-10,000 170-650	-	-	-	2	4	5	5	5	5	5	-	15	40
NASA	Observation	OSO	Orbiting Solar Observatory	THOR	DELTA	165	350	300	-	3	3	-	-	-	-	-	-	-	-	—	—
NASA	Nuclear Test Vehicle	RIFT	Chemical Launch of Nuclear Upper Stages	SATURN, SI	NUCLEAR	500	19,000 5,000	350 Escape	-	-	-	-	-	-	1	2	2	2	2	10	19
NASA	Exploration	MOONSHOT	Early Circumlunar Probe	ATLAS	ABLE	390	—	Escape	1	1	-	-	-	-	-	-	-	-	-	—	—
NASA	Exploration	MERCURY	Man-in-Space Early Satellite	REDSTONE ATLAS	— —	78 390	2400	120	1 -	10 7	- 6	- 1	-	-	-	-	-	-	-	—	—
NASA	Exploration	APOLLO	3-Man Space Capsule, circumlunar and orbital flights	ATLAS SATURN, SI	AGENA B SIV, SV	1500	20,000 8,500	300 Escape	-	-	3	3	1	2	2	2	2	2	2	10	22
NASA	Observation	RANGER-1-2	Interplanetary Flights	ATLAS	AGENA B	390	700	Escape	-	2	2	2	1	-	-	-	-	-	-	—	—
NASA	Exploration	RANGER-3-4-5	Hard Lunar Landing	ATLAS	AGENA B	390	2,500	Escape	-	-	3	-	-	-	-	-	-	-	-	—	—
NASA	Exploration	SURVEYOR	Soft Lunar Landing	ATLAS	CENTAUR	390	2500	Escape	-	1	4	5	4	4	4	-	-	-	-	—	8
NASA	Exploration	PROSPECTOR	Soft Lunar Landing and Return	SATURN, SI	SIV, SV	1500	2500	Escape	-	-	-	-	-	1	1	1	1	1	1	5	11
NASA	Exploration	MARINER	Mars and Venus Probe	ATLAS	AGENA B CENTAUR	390	8,500 1,500	300 Escape+	-	-	1	2	1	1	1	1	-	-	-	15	18
NASA	Exploration	VOYAGER	Advanced Planetary Landings	SATURN, SI	SII, SIV, SV,+	1500	—	Escape+	-	-	-	-	-	1	1	1	1	1	1	5	11
NASA	Exploration	MAN-ON-THE MOON	Manned Lunar Landing and Return	NOVA (F-1)	—	10,000	135,000	Escape	-	-	-	-	-	-	-	-	1	2	2	15	20
NASA	Communication	ECHO	Passive Communication Satellite	THOR	DELTA	165	130	1000	2	1	1	-	-	-	-	-	-	-	-	—	—
NASA	Communication	REBOUND	Same Advanced Version (multiple)	ATLAS	AGENA B	390	—	—	-	-	1	10	15	20	2	2	2	2	2	—	30
INDUSTRY	Communication	INDUSTRY PROJECT	Commercial Communication Satellite	UNKNOWN	—	—	175	2200	Unknown											—	60
ARMY	Communication	COURIER	Repeater Communication Satellite	THOR	ABLE STAR	165	475	650	1	4	-	-	-	-	-	-	-	-	-	—	—
ARMY	Communication	ADVENT	24-hr Stationary Repeater Satellite	ATLAS	AGENA B	390	600	22,300	-	2	2	2	2	3	-	-	-	-	-	15	13
NAVY	Navigation	TRANSIT	Beacon Satellite for POLARIS Subs	THOR	ABLE STAR	165	230	230-430	2	4	6	6	8	8	8	8	8	8	8	40	83
AIR FORCE	Surveillance	SAMOS	Photographer Satellite w/Recovery	ATLAS	AGENA B	390	4000	250-300	3	10	20	8	8	8	6	6	6	6	6	30	63
AIR FORCE	Surveillance	MIDAS	ICBM IR Detection Satellite (8-12)	ATLAS	AGENA B	390	5000	300	-	3	10	10	10	10	8	8	8	8	8	40	50
AIR FORCE	Surveillance	SAINT	Ground-Launched Inspection Satellite	ATLAS	AGENA B	390	3500	600	-	4	4	4	8	6	6	6	6	6	6	30	65
AIR FORCE	ICBM Defense	BAMBI	Satellite and AICBM	ATLAS	AGENA B	390	—	—	-	-	-	2	4	6	6	6	6	6	6	30	65
AIR FORCE	Satelloid	DYNA SOAR I	Reconnaissance and Bombing Glider	TITAN II (SATURN)	TITAN 2nd+	400	2-2.5 Tons	60	-	-	2	2	4	3	3	-	-	-	-	13	16
AIR FORCE	Space Plane	DYNA SOAR II	Reconnaissance and Bombing Glider	SATURN		1500	—	—	-	-	-	-	-	-	-	-	-	-	-	—	—
AIR FORCE	Satellite Test Vehicle	DISCOVERER	—	THOR	AGENA B	—	—	—	-	-	-	-	-	-	-	-	-	-	-	—	—

1960 1965 1970 1975

Figure 2 -- Relative Increase in Movement or Delivery of Boosters Based on Estimated Number of Flights

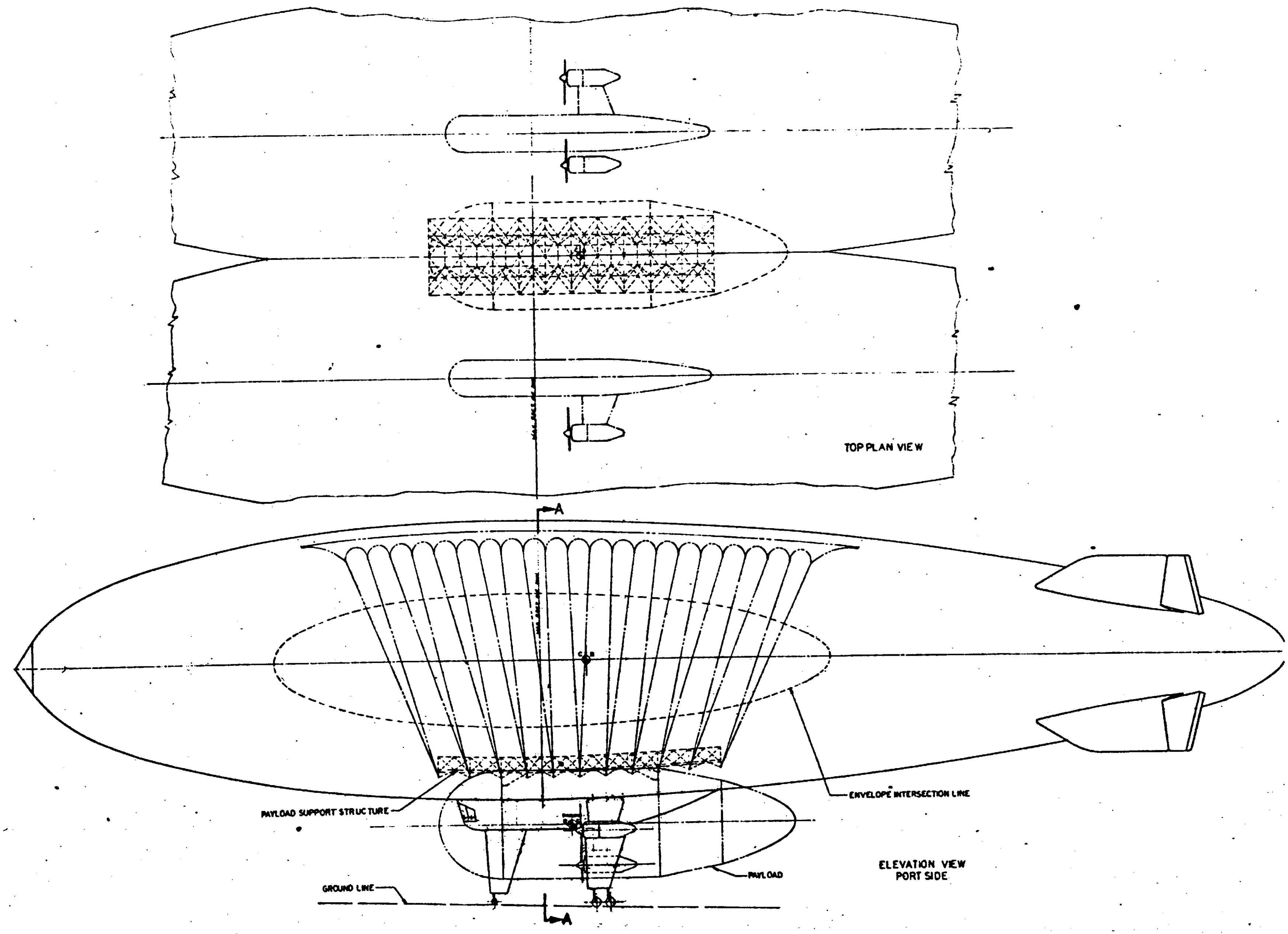

A
TOP PLAN VIEW
ENVELOPE INTERSECTION LINE
PAYLOAD SUPPORT STRUCTURE
PAYLOAD
ELEVATION VIEW
PORT SIDE
GROUND LINE
A

FIGURE 10 A

REQUIREMENTS

GOODYEAR AIRCRAFT CORPORATION

- INITIAL
  - IMMEDIATE IMPLEMENTATION
  - LOW VEHICLE COST
  - LOW OPERATING COST
  - FACTORY TO LAUNCH SITE
  - HIGH RELIABILITY
  - SHORT TAKE-OFF AND LANDING
  - CONUS COVERAGE
  - PAYLOADS UP TO 20,000 LB
- INTERMEDIATE
  - PAYLOADS UP TO 90,000 LB
- FUTURE
  - VTOL
  - WORLD-WIDE COVERAGE
  - PAYLOADS UP TO 600,000 LB

FIGURE 4

METHODS OF APPROACH

GOODYEAR AIRCRAFT CORPORATION

- INITIAL
  - MODIFY EXISTING AIRSHIPS
- INTERMEDIATE
  - MODIFY AND ENLARGE EXISTING AIRSHIPS
  - BUILD NEW AIRSHIPS
- FUTURE
  - DESIGN AND BUILD A NEW AIR TRANSPORT SYSTEM

FIGURE 5

MODIFIED ZPG-3W

GOODYEAR AIRCRAFT CORPORATION

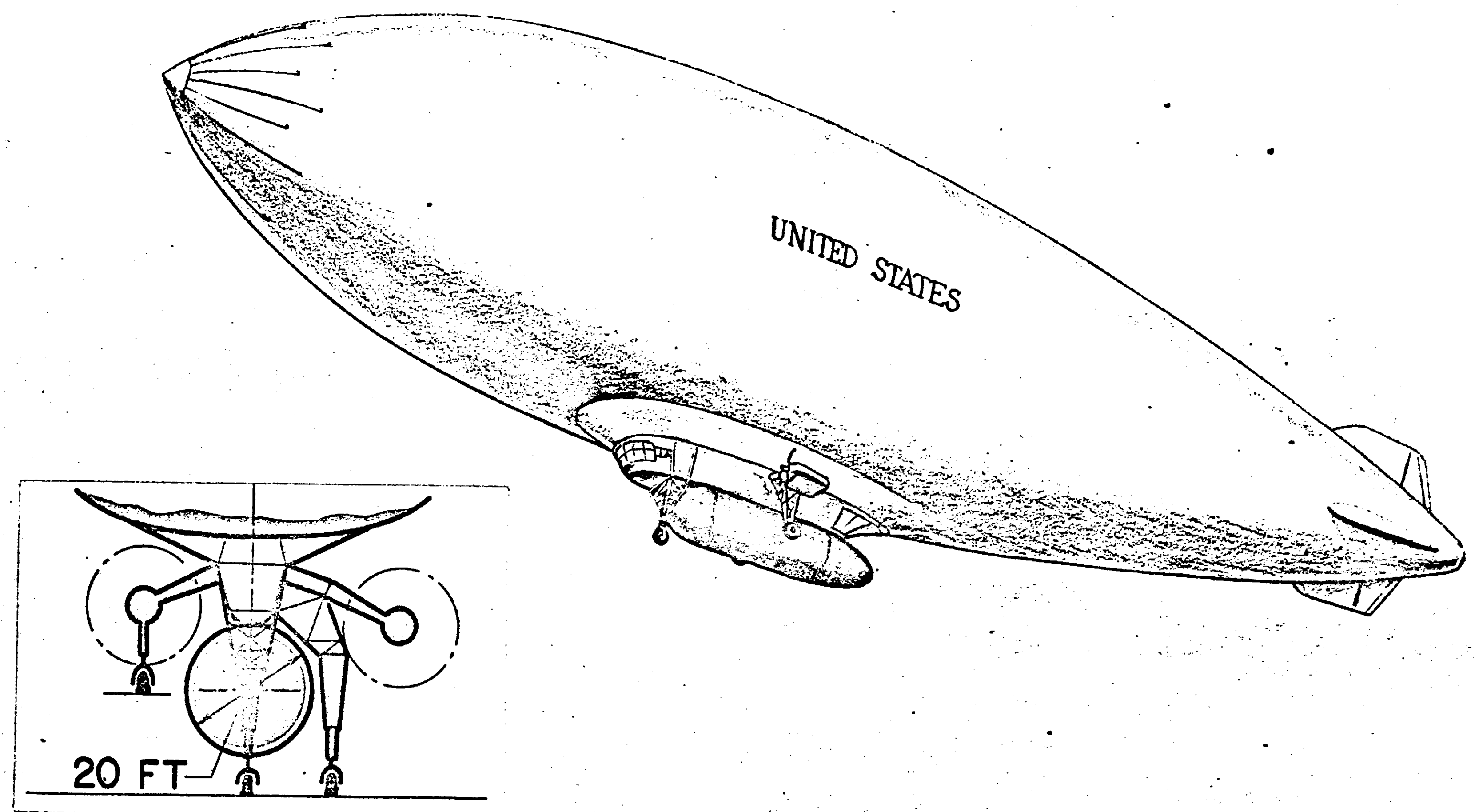


FIGURE 6

MODIFIED ZPG-3W MASTING

GOODYEAR AIRCRAFT CORPORATION

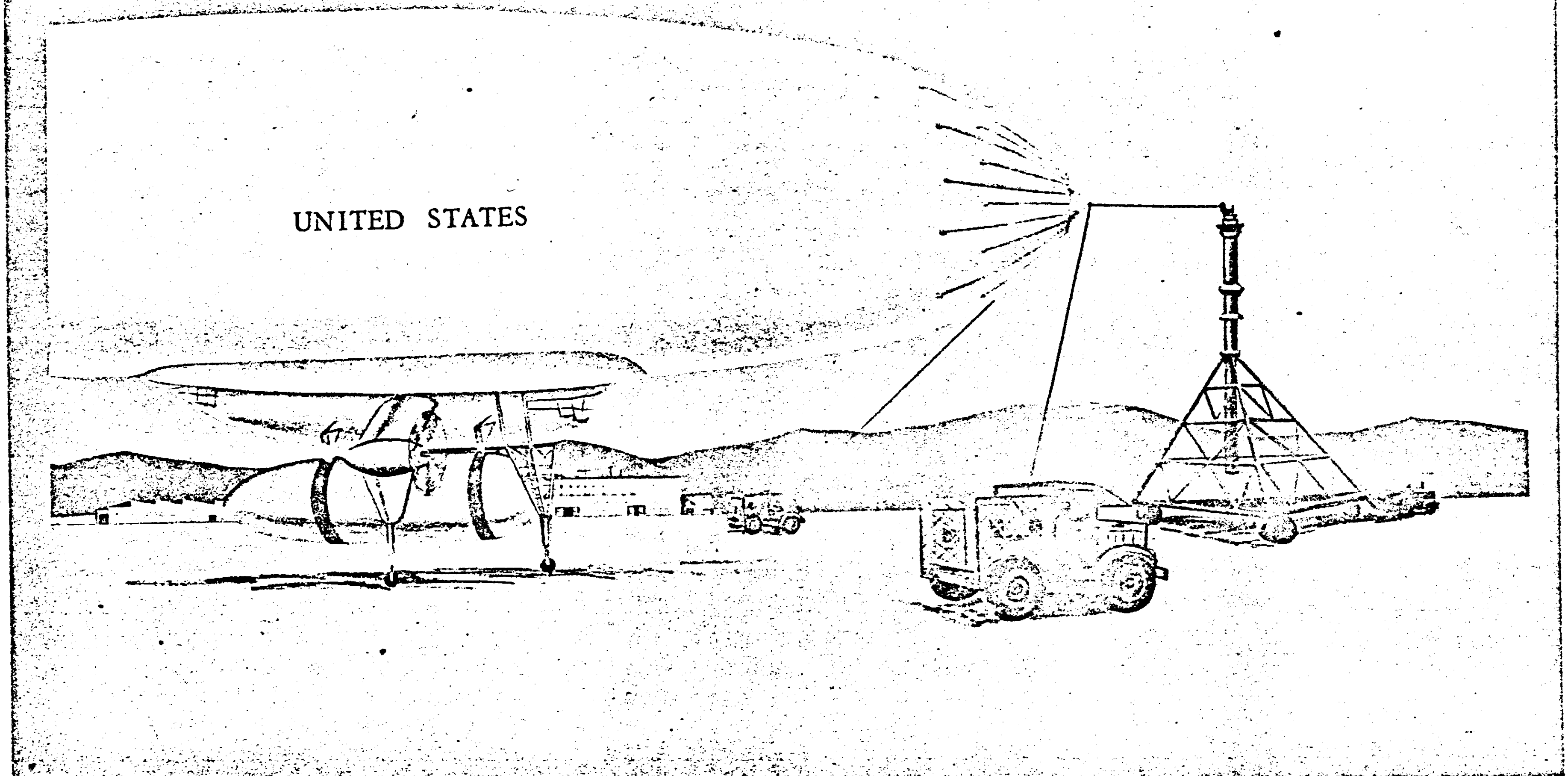


FIGURE 7

TAKE-OFF AND LANDING AREA

GOODYEAR AIRCRAFT CORPORATION

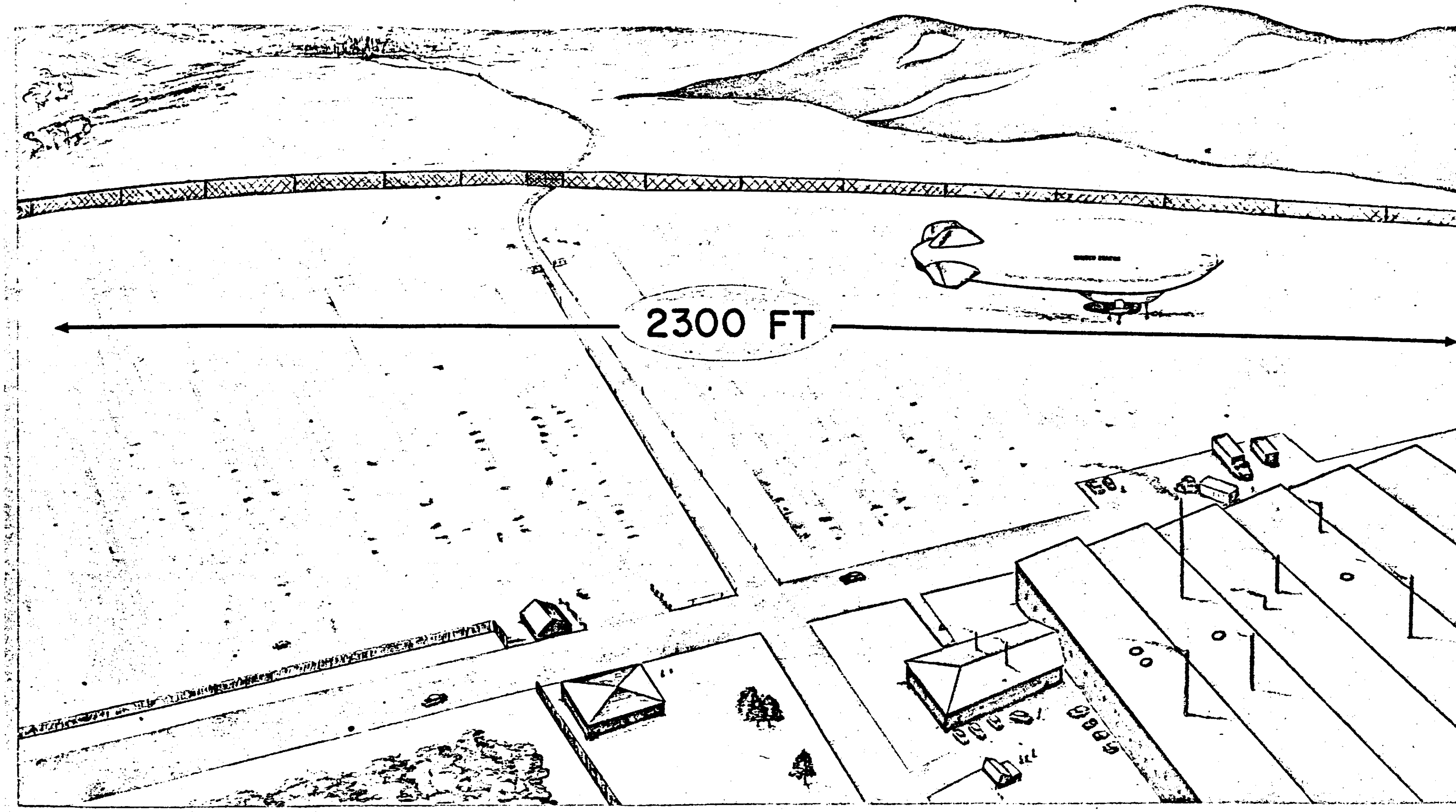
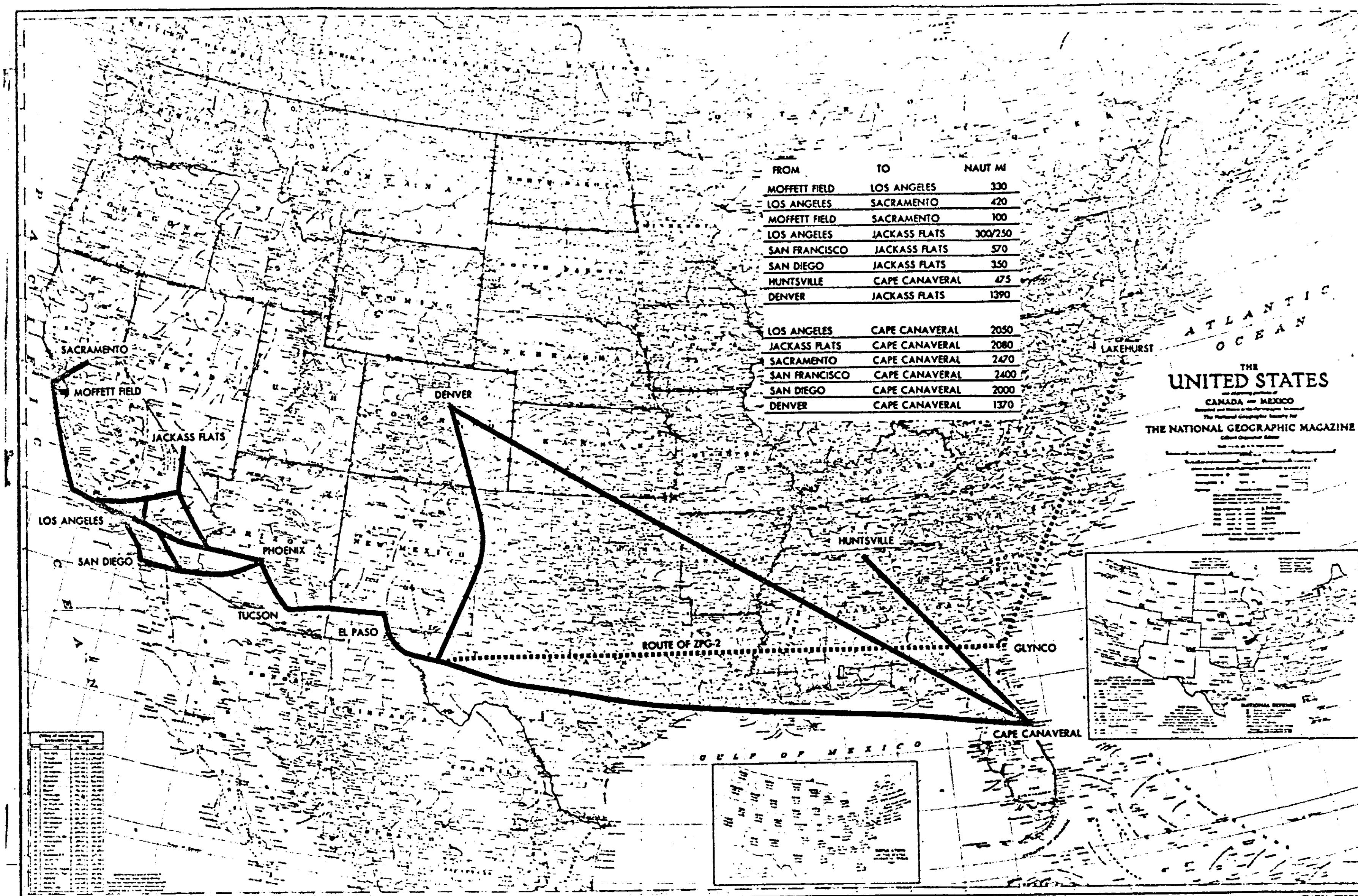


FIGURE 8



FROM	TO	NAUT MI
MOFFETT FIELD	LOS ANGELES	330
LOS ANGELES	SACRAMENTO	420
MOFFETT FIELD	SACRAMENTO	100
LOS ANGELES	JACKASS FLATS	300/250
SAN FRANCISCO	JACKASS FLATS	570
SAN DIEGO	JACKASS FLATS	350
HUNTSVILLE	CAPE CANAVERAL	475
DENVER	JACKASS FLATS	1390
LOS ANGELES	CAPE CANAVERAL	2050
JACKASS FLATS	CAPE CANAVERAL	2080
SACRAMENTO	CAPE CANAVERAL	2470
SAN FRANCISCO	CAPE CANAVERAL	2400
SAN DIEGO	CAPE CANAVERAL	2000
DENVER	CAPE CANAVERAL	1370

FIGURE 9

TWIN ZPG-3W'S AIRBORNE

GOODYEAR AIRCRAFT CORPORATION

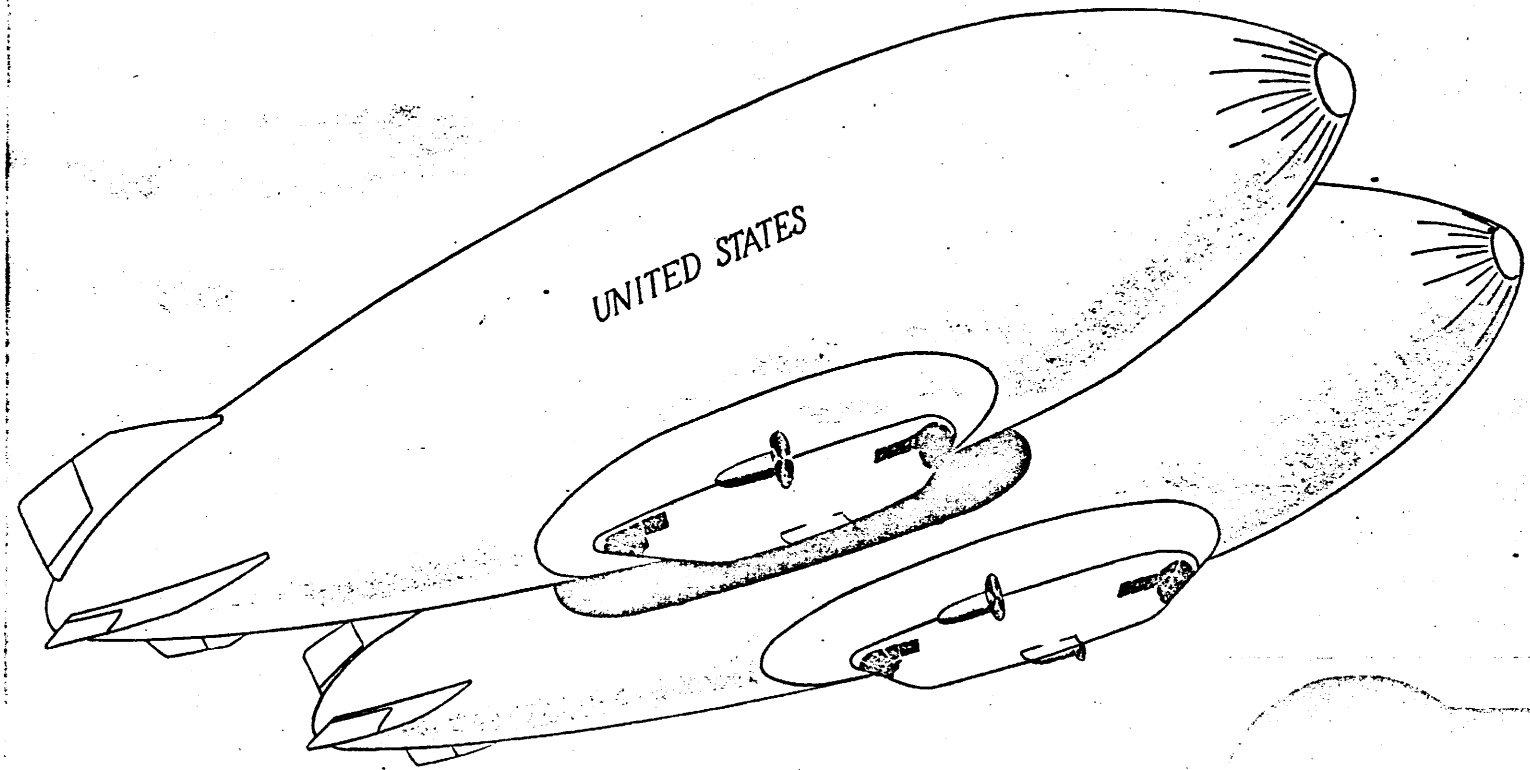
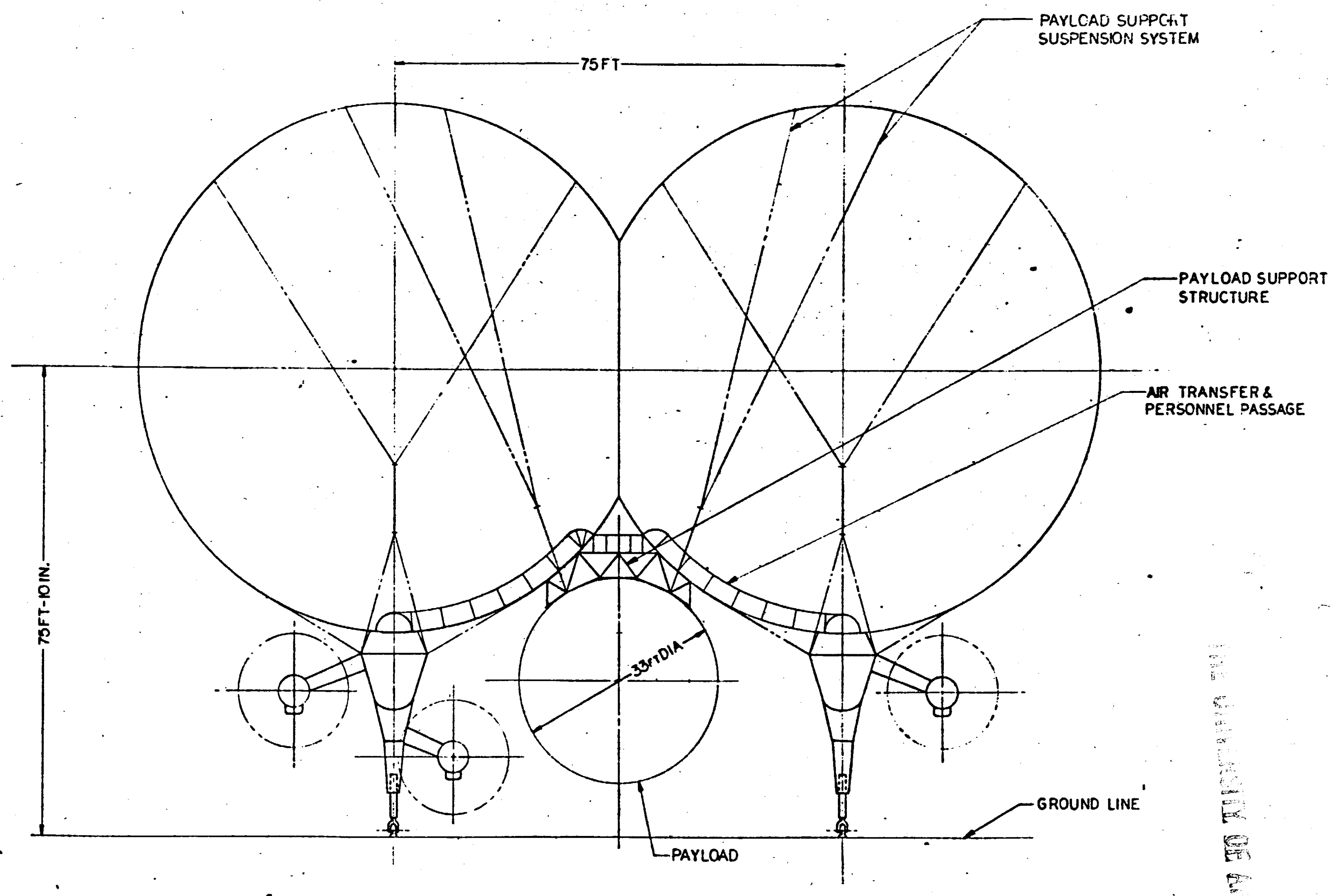


FIGURE 10



A A
1/100
PARALLEL ℄

FIGURE 11

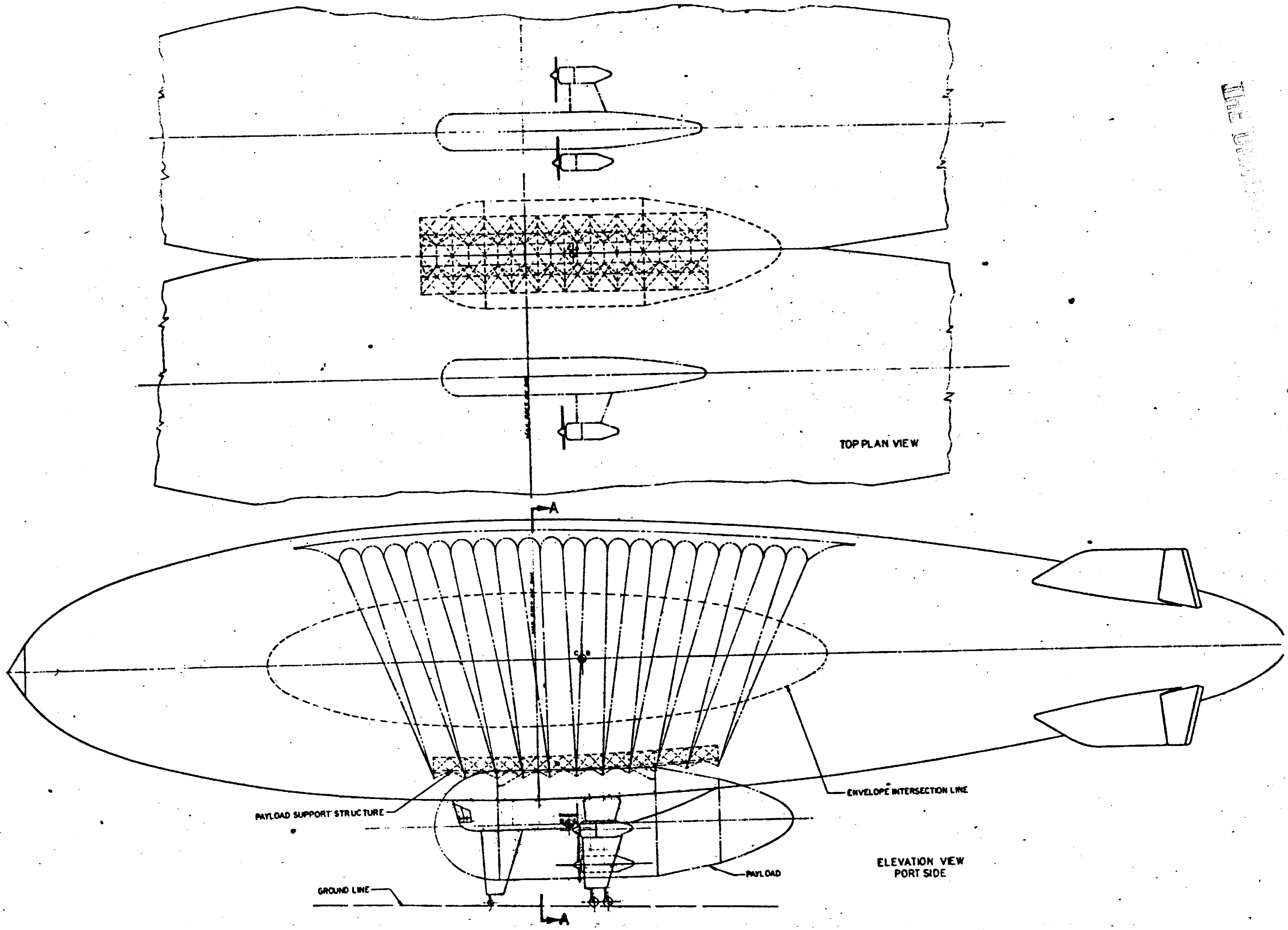

TOP PLAN VIEW
A
PAYLOAD SUPPORT STRUCTURE
ENVELOPE INTERSECTION LINE
ELEVATION VIEW
PORT SIDE
PAYLOAD
GROUND LINE
A

FIGURE 11

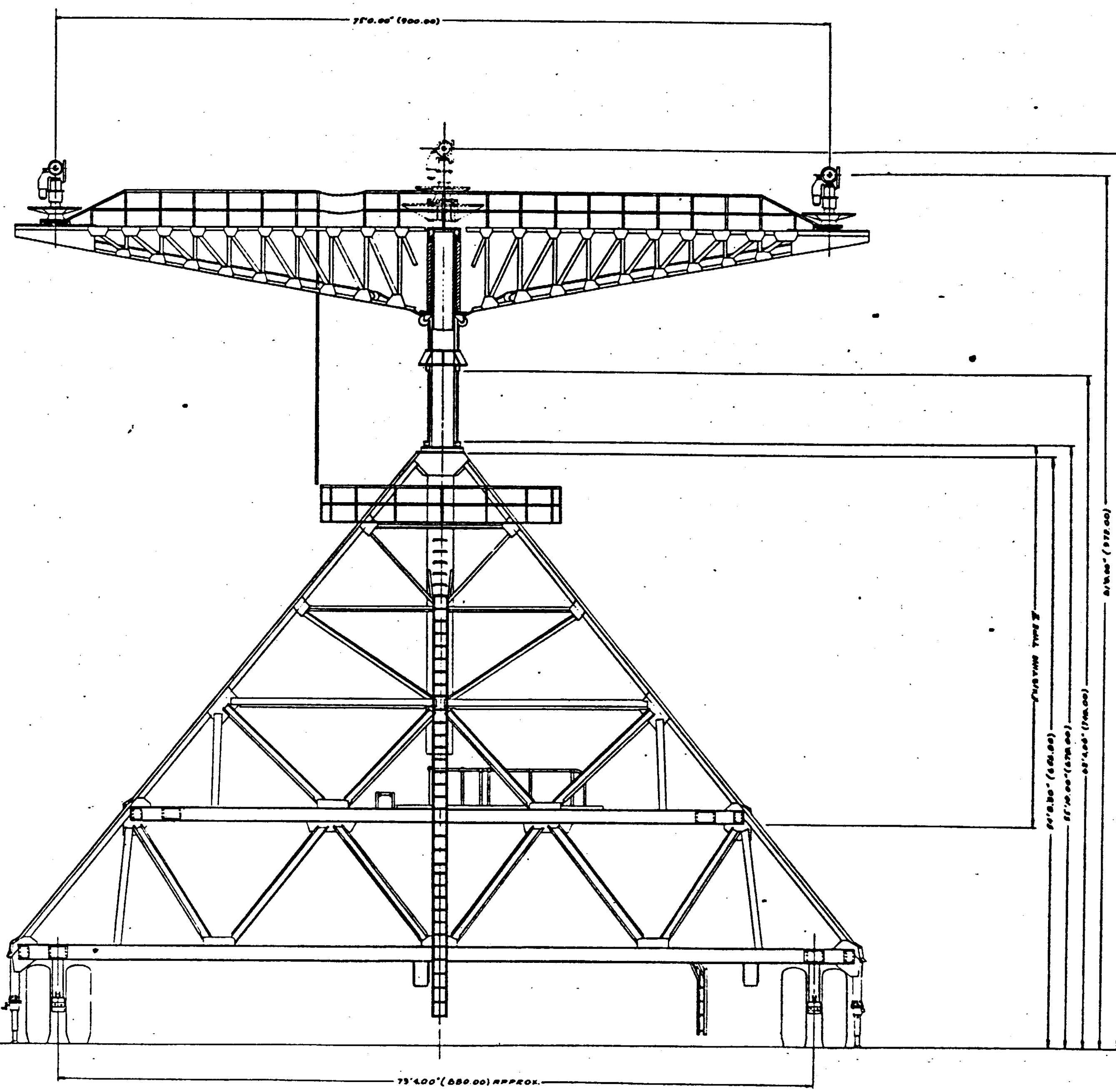


FIGURE 12

AIR TRANSPORTER IN GAC DOCK

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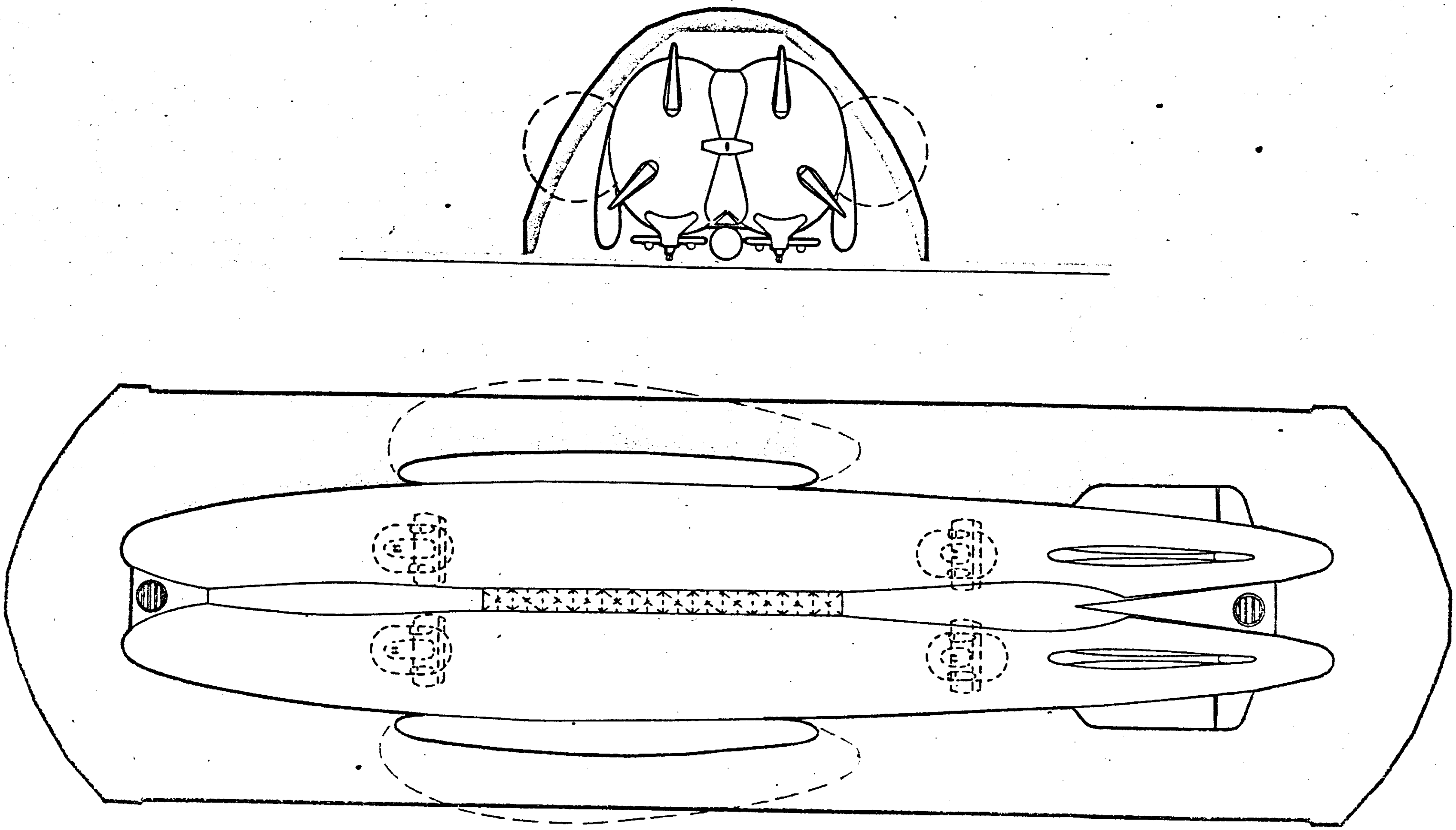

FIGURE 13

AIR TRANSPORTER AIRBORNE

GOODYEAR AIRCRAFT CORPORATION

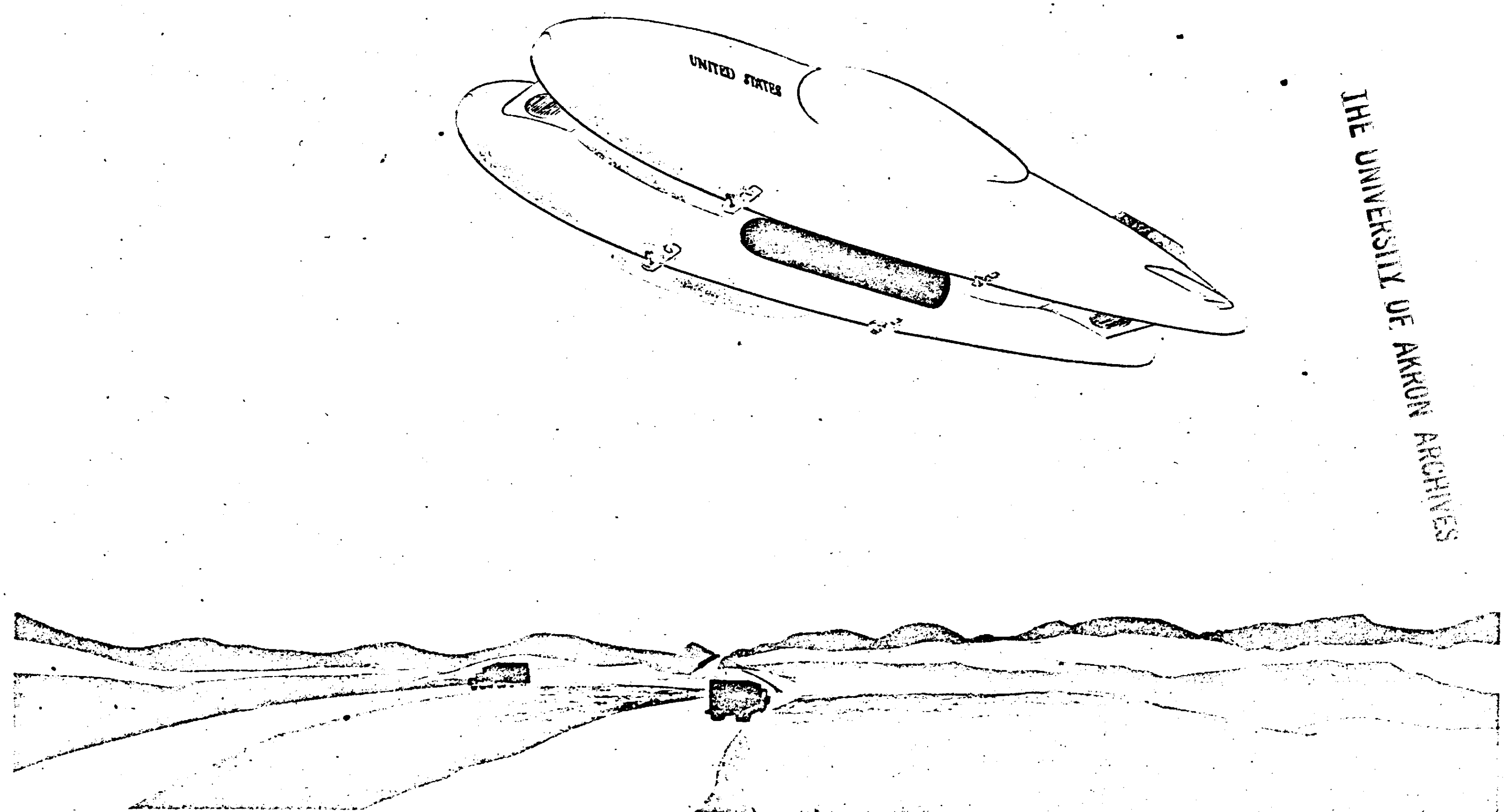

FIGURE 14

AIR TRANSPORTER MOORED

GOODYEAR AIRCRAFT CORPORATION

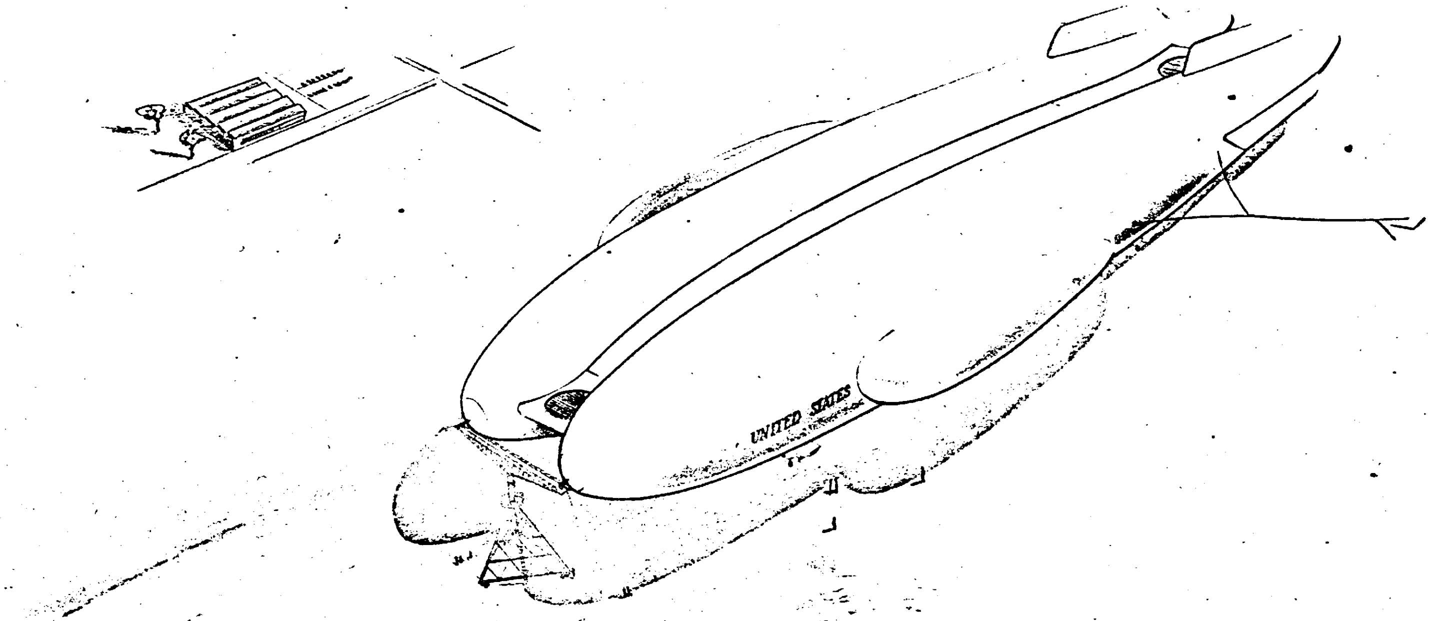

FIGURE 15

COMPARATIVE DATA

GOODYEAR AIRCRAFT CORPORATION

CONFIGURATION (CU FT)	CAPACITY (LB)	LEAD TIME (MONTHS)	COST ($ MILLION)
MODIFIED 3W (1,500,000)	20,000	9	1.444
TWIN 3W (3,000,000)	50,000	18	3.4
TWIN 3W ENLARGED (4,000,000)	90,000	21	4.8
NEW AIRSHIP (3,000,000)	70,000	30	11.25
NEW AIRSHIP (4,000,000)	100,000	30	13.5
AIR TRANSPORTER (15,000,000)	600,000	36	40.0

FIGURE 16

PERFORMANCE CHARACTERISTICS

GOODYEAR AIRCRAFT CORPORATION

CONFIGURATION	AIRSPEED (KNOTS)		OPERATING ALTITUDE (FT)	DESIGN RANGE (NAUT MI)	PAYLOAD (LB)
	CRUISE	MAX			
MODIFIED ZPG-3W	45	75	5,000	800	20,000
ENLARGED TWIN ZPG-3W	45	75	5,000	800	90,000
AIR TRANS-PORTER	55	75	5,000	3,000	600,000

FIGURE 17

OPERATING COSTS

GOODYEAR AIRCRAFT CORPORATION

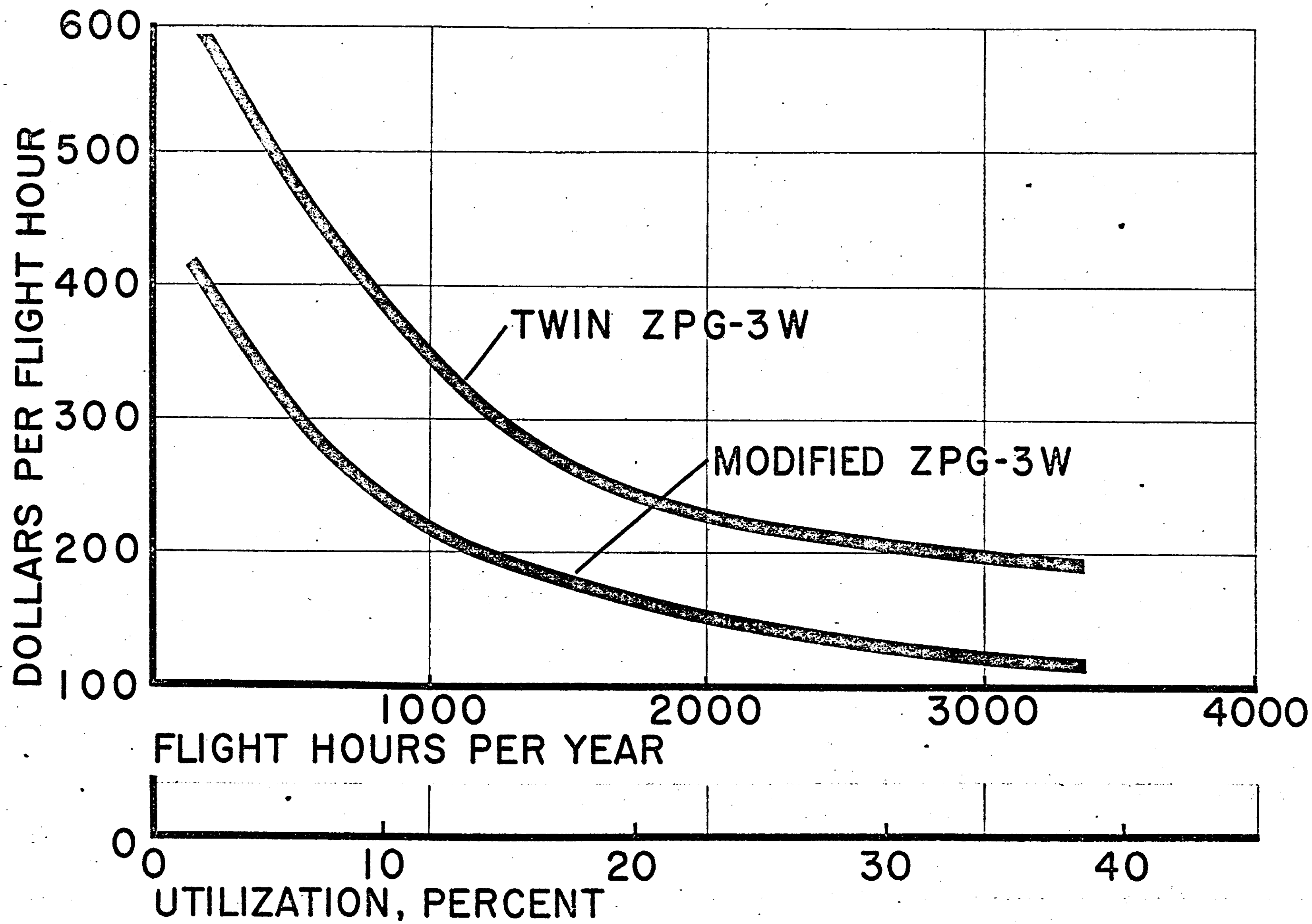

FIGURE 18

SCHEDULES

GOODYEAR AIRCRAFT CORPORATION

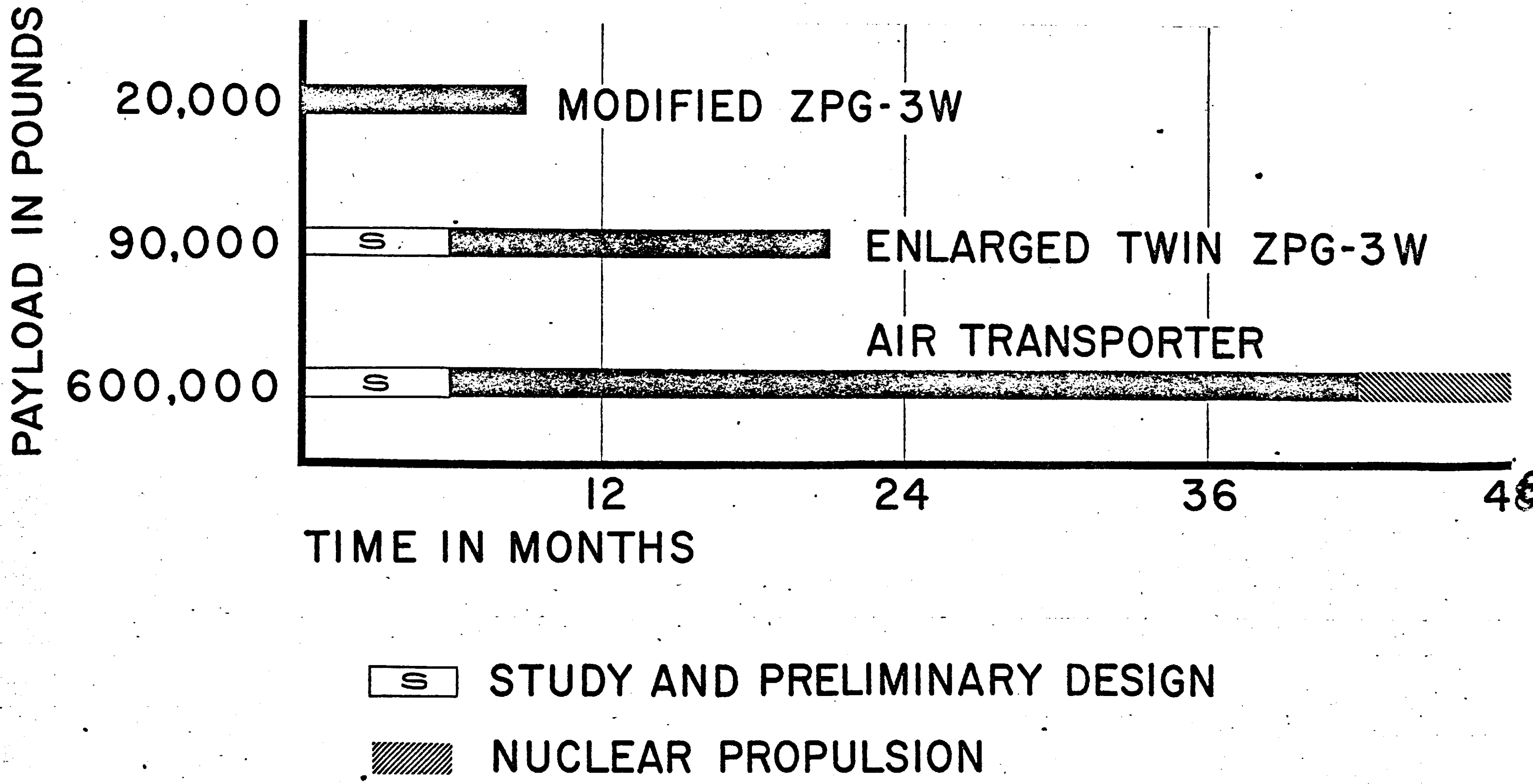

FIGURE 19