Transkription eines Briefes von A. M. Herring an O. Chanute Id: **18661**

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My address is 184th St and Valentine Avenue

N. Y. Oct 1st/94.

Mr. O. Chanute

Dear Sir.

Your letter received yesterday. Since writing the letter which I requested Mr. French to forward to you I have not been able to continue my experiments with the Lilienthal machine. I cannot say that I have as yet mastered the art of balancing the machine perfectly as in my trials an average of only about one in ten trials would give a flight which exceeded five times the decent [?]. If you add the distance traversed by the wind, to that covered by the machine, many of the trials would show a flight exceeding ten times the fall and one would probably exceed sixteen times the decent [?], with the machine traveling at a velocity not exceeding 24 miles including that of the wind, and with the surfaces loaded at more than 1.3 pounds to the square foot. This would be indicated a HP of 24 x 180/16=270 mile pounds an hour, roughly 78 of one HP, or about 231 pounds per horsepower a result which is so large as to necessitate the belief that the wind must have had a decided upward trend – the amount of this I do not know – but assuming that the trend was as great as the slope of the hill (I do not think it was) or 1 to 4, and taking the velocity of the wind as 12 miles or half the combined velocities, then the fall compared with the horizontal distance, would be; the observed fall or 1/16 Distance; + ¼ of ½ the distance, or a fall of 3 in 16 and the amount supported would be 231/3 or 77 lbs per horse power, which only goes to show what enormous errors are possible from an apparently very small cause. If now we assume the shaft HP of a steam engine to be 60% of the indicated HP, and the push of the screws to be 60% of that we should have an actual efficiency of 36% of 77 lbs or 27.72 lbs per <u>indicated</u> horsepower in effective support, a result which is very close to the results obtained by Mr. Maxim; – gratifying in its possible accuracy, but very discouraging in its quantity. I hardly think however tat the upward trend of the wind exceeded 10%., result 1/16 + 1/2(1/10)=9/80, 128.3 lbs per actual "push" HP or with same efficiency as before with steam engine and screws 46.18 lbs per <u>indicated</u> horsepower. I use a considerable portion of my spare time in completing the design I have commenced, of a steam engine to indicate about 6 HP and furnish about 2.2 HP at least, in "push" of screws, these 2 engines, each 3 HP, with boiler condenser pumps tanks, casings, shafts, water and fuel

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(for 1 hour) propellers (6 feet diameter) shafting & bearings for same I estimate will weigh not more than 38 pounds, + 2.2 [?] 18 lbs per H.P. not less than 34 lbs. The (l) boiler to be made of seamless steel tubing about 9 square feet heating surface but so arranged in a star shape system of coils as to expose at least 3.6 square feet of surface to the flame. The thinnest coils will be 3/8 inch outside diameter of tubing, and 28 to 31 Birmingham Wireguage. The dome and return pipes will be about 20 B.W.G. The circulation of the water on the boiler is forced by a very small turbine, or 4 bladed screw driven by a little band from the engines or rather one of them. The engines themselves will be made almost wholly of seamless drawn steel tubing from 20 to 28 guage. The tubing I can get here has trifle over one half of one per cent of carbon and will harden and temper sufficiently to prevent undue wear, a small piece which I tested gave 82.000 lbs tensile strength, 6 ¾ % ductility with the grain (lengthwise of tube) part of same tube, hardened & dipped in oil gave tensile strength (with grain) 121.000 lbs, ductility about 4 of 1%, and across the grain 87.000 lbs one piece, and 79.000 another, both hardened. For the engines I use factor of safety of 5 ½ to 8, and use factor of ultimate strength as 79.000 lbs per square inch. A few of the parts of engines are made of best tool steel, a test of one piece of quality I intend using when hardened & tempered to first blue to (resist shock) showed a strength of 179.000 and was not brittle. I intent trying first compound and later the tripple [?] expansion type of engines, I prefer the latter not on account of the greater economy which in a small high speed engine would be very alight but because the strains are more uniform and my design provide a complete balancing of all the moving parts both around the axis and in the horizontal plane (the engines are horizontal ones). The piston heads are to be hollow and are packed with simplest yet most efficient device you could imagine [?], it is a metallic "cup leather" formed of either brass or tempered steel which after being tempered is ground to a very close fit in the cylinder on the outside [?], and which is then thinned down by grinding on the inside until for the distance of 1/8 inch on each end it is only about .005 inch thick this ring which then contains the two cup leathers for the prison is screwed on to the latter and held in place by a small screw.

[Abbildung]

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The heavy standing is the cup leather (in section). The lighter shading shows section through piston head & rod. The distance from the piston head to the cup leather, (the distance BA) is actually only about 2/100 of an inch. The piston and valve rods will probably have similar packing for their glands. The cylinders are brazed and welded into shape, hardened and tempered then ground true and to size, this grinding will be exceedingly slight it will hardly add 1/100 inch to the internal diameter of the cylinders. The feed pump is not attached directly to the excentric but both are attached to different parts of a flexible lever made of tempered tool steel, which it is hoped will relieve the shock due to high speed; the inlet and exhaust valves to feed pump have about 3 times the open area of the pump cylinder and are very light, feed pump single acting variable stroke regulated by a manometer tube which moves the connection nearer or further from the fulcrum of the spring beam as differential pressure changes (this regulation adds 2/10 lb to the weight of the engines)

The differential pressure, is the difference between the boiler pressure and the pressure in a closed tube filled with water which passes through the fire box and also through the boiler is attached to one flattened U tube and the "closed coil" to another, one end of each are [?] fixed, the other ends or free ends of the U tubes are joined together so as to pull in opposite directions.

[Abbildung]

The above is a diagramatical illustration. S represents the shaft and excentric which moves the spring lever PCF. F is the fulcrum of the lever C is the point where the excentric rod is attached and P is the block to which the connecting rod of the force pump is joined. PB is the (dotted line) link which shifts the block P and alters the throw of the pump. The upper tube (ending at B) leads to the closed coil while the lower one leads to the boiler (both connected by tubes 1/8 inch outside diameter).

A link joins B and C. If now the pressure in the coil is the same as the boiler, the block P will be near the fulcrum and the stroke of the pump will be short – to whort

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to supply the water necessary.

If now the water lever fails too low the pressure in the closed coil increases above that of the boiler, the upper U tube tends to uncoil, which it does and at the same time pushes the Block P further out on the spring lever and increases the pump's stroke the increase will be from 2.5 to 5 times the shortest stroke. The fire is regulated by another U tube from the boiler which is connected to a "pin hole" valve in the supply valve pips from the gasoline tank. As the pressure in the boiler rises the expansion of the U tube gradually cuts off (never quite entirely) the supply of gasoline to the bunsen burners under the boiler; the other attachments to boiler are a couple of guges [?] (1 1/8 diameter) and a safety valve -, all of which are simple and "as thin as paper". The designs are sufficiently feasable for me to feel convinced that with a drill press, forge, lathe and willing machine, I could construct any part of them myself. The water level and steam pressure are automatic, also the fire. Either engine can be stopped and started without moving the centre of weight at all, shutting off the engines slows the fire but I have not provided any way of entirely putting it out until you land.

To return to your questions about the machine built like Mr. Lilienthal's. The plan of it is, roughly speaking a semicircle.

[Abbildung eines Gleiters nach Lilienthal-Art]

The heavy curved lines in the centre are eliptical shaped (section) bars which bear the weight of the body; their total length being about 12 feet projecting 4 feet beyond the mains joints (A & B) (spruce ⬯) The major axis of the ellipse is of course vertical = 2 ¾ inches at the thickest part of the bars; the monor axis at the same place is about 1 ¼ inches the ends are about ¾ inch by 7/8. or nearly round. The first radial in this section ⬭ ¾ x 1 ¾ at its widest and

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thickest part. (.4 its length measured from the outer end). The size of the ends are [?] about 9/16 x 1 ¼.

The second radial BD is about 1 ¼ x 5/8 at is [?] largest part, which occurs about the same place. The ends of this beam are 1" x ½. The other 3 beams on each side are about 9/16 x 1" at the biggest part this section (9/16 ↕) more or less. - that is the ends are much blunter they taper slightly to their ends which are 7/8 x ½. The tail as shown is too large it is about 7' x 8' more or less. There are two "stretchers" on each wing 8' long and of section 1" x ½ (oval) to ½ x 3/8 they are tied by strings to each stick they cross. No holes are made in any stick except at the very ends. - I used metal plates at A & B on each of the radials but I think they are more heavy then beneficial. The whole machine cost me all told about $7.00/100 and three months work. It is amply strong. I turned it upside down and hold it up by ropes attached to the "arm" bars about where the centre of pressure ought to be then loaded it with nearly 300 pounds and sprinkled over the surface – most in front. I use only perfectly clear straight grained spruce, and generally selected the white or sap part. The wires are piano-steal-wires 188,000 lbs to 253,000 lbs per square inch tenacity I use figure 160,000; factor of safety about 6; where important & 5 where not. (none of the wires ever broke) For strength of sticks I use formula

$$\frac{\text{Moment of inertia x 7.000 x 8}}{\text{distance, inches, from neut. axis to farthest fibre x span inches}}$$

(Trautwine's Engineering Pocket Book page 488)

This is supposed to give the ultimate strength but I constructed my first machine and used it without allowing any factor of safety except asuming [?] my weight to be 160 pounds instead of 155 it held up nearly 250 pounds sand, only slightly straining one stick which had a flew I had not noticed before.

My surfaces were made of nansook [?] muslin (very thin) and varnished with shellac they are very much stiffer and harder than oil varnished fabric. They never quivered [?] in the wind. I do not think birds soar by the wind alone as Mouillard an a great many others claim, because I have seen them soar under conditions which with even the most favorable formulae we possess would not furnish them with sufficient power to continue their flight – but they continue it and that too so near the ground that the condition of wind could not have been materially different – then again every time I

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have been near and under a buzzard who was rising in "spirals" I have noticed that peculiar noise like the buzzing of a huge horse-fly or a swarm of them – You do not hear it every time one of these birds pass near you or over your head because I suppose they are not always "working", as must be the case when they are rising. Since this summer I am convinced that this sound is common to other soaring birds as well. While up at Croton in this state (N. Y.) I had a chicken hawk pass twice over my head in the course of his spiral ascent the first time he was only about thirty feet above me when the sound was very distinct the second time I presume he was 80 feet or more above me, this time, the sound could be still distinctly heard but of course was much fainter.

The balancing and gliding of a Lilienthal machine is I presume very much like riding a bicycle or rather learning to without a teacher – but probably as easy to control after you have mastered the art (which I haven't) as a bicycle is. The difficulty in beginning with a soaring machine is not the regulating of the centre of weight enough but that the slightest shifting of you position forward or backward alters the angle too much.

The lateral equilibrium does not require much attention. I think it would require a year to learn to controll a machine properly just to soar. The addition of an engine and propellers would I think add but very little to the difficulties to be overcome, but of course his is only conjecture; it was however easier to handle my first machine which weighed about 15 pounds than the present one which weighs 26 ½.

I am very much surprised you should have seen an article in a Rochester paper or any other publication in reference to my experiments as with the exception of no. 3 Aeronautics I have newer written any article or authorized any by furnishing information for publication. I should like to know what the clipping you refer to contains.

You will probably wonder why in view of the calculation on previous pages I have allowed so little margin in the power of my engines – it is because with the machine and motors the weight would be about as much as I can conveniently handle – secondly because I believe I can with considerable practice greatly exceed the best results I have yet obtained because in almost every trial I have been conscious at the time of errors committed in the adjustment of the equilibrium, errors which though slight show a second or so later in either considerable "drop" or in arrest of speed. If the soil were nice, smooth (free from bushes and high weeds) and soft, and the descent [?] were a long one I should add a shifting seat to the machine; but

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suitable places, with the time and means at my present command are difficult to find. With a seat and practice I firmly believe the guiding balancing and other adjustments would become so wasy as to be as much a second nature as they are in riding a bicycle or walking.

Knowing the deep interest you have taken in the subject I have written to an extent that I fear may be a burden to read.

It is hard to say when the designs and engines will be complete as I am not entirely a person of leisure – I am a mechanical & civil engineer and endeavoured a few years ago to build up a consulting business but had times and panics as you doubtless know hit our profession first and "with the biggest brick too." Work because so slack about a year ago, that rather than be entirely idle I because a chainman on the New York Central R. R. where I am working pending a better opportunity, or a sufficient revival in trade and new enterprises for me to build up a trade of my own – Railroading I think for many years to come has reached its high water-mark; new construction will be slight and in general will be only the extension of existing systems and consequently will offer little opportunity to those who might pose as locating engineers. In the mechanical branch, I think the changes in the tariff will tend more to make marine engineering the most promising field.

The gradual increase in population on the other side, ought I think, to offer its most inviting field to the civil engineer in the survey and construct [?] of irrigation systems in the West. If by chance, you should run across [?] any one who is short of a man in this or a similar line – anywhere from assistant to chief assistant I should be glad to apply. I have often thought of going to the west, but the nearest I ever came to it was when last July Mr. Van Anken asked me for my letter of locating engineer – it was my first acquaintance with him and the last I have heard of him except through the newspapers.

I have secured a place out in the suburbs where I hope to have a little experimental shop but do not think there is any place near from which to practice "flying." If you are in the city any time during this fall or winter I should be very pleased to have you come out and see me and talk on the subject as much as you like; it would be pleasure to me to give you any information which might be of interest or ser-

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vice to you. I have tried almost every combination and shape of surface I could immagine and have built many models – several that flew – two with steam; but, if the strictest line were drawn, they would all be classed as different degrees of failure.

Yours very truly,

A. M. Herring.