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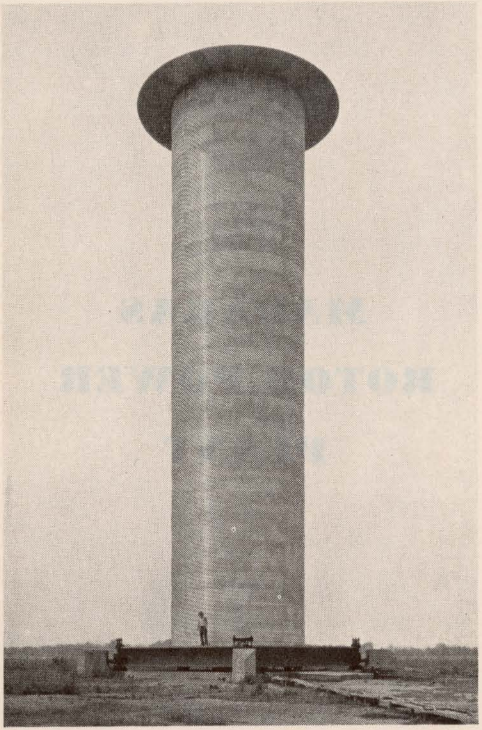
The MADARAS ROTOR POWER PLANT

"A New Era in Power Generation"

The

MADARAS ROTOR POWER PLANT



THE FIRST FULL SIZE ROTOR
Burlington, New Jersey

I dedicate the Madaras Rotor Power Plant to those who have faith in the continuous progress of humanity toward a more ideal and independent life.

Julius D. Madaras

BY utilizing the internal energy of the flowing ocean of air for generating electric power, the Madaras Rotor Power Plant actually makes possible the creation of a new economic era.

The wind is universally present in every community and in every country. No fighting armies need conquer or defend this source of power. No hordes of laborers must be conscripted to descend thousands of feet into the earth to dig it out. And human life need suffocate no more in a smoke laden atmosphere that is the present price we pay for heat and electric power.

Soon giant cylinders spinning in a smoke-clean sky will be seen pushed around on mammoth circular tracks by the wind.

And power by means of the Madaras Rotor Power Plant will be generated at one-fifth the cost of power by steam or

hydro plant. The capital investment in the Madaras Rotor Power Plant is about one-third that of a steam plant and one-fifth that of a hydro plant.

In addition to making present day applications of electricity more economical, the Madaras Rotor Power Plant is destined to bring new meaning to the Electrical Age. It will make possible the use of electricity for heating and air conditioning, for more general transportation, for the manufacturing of chemicals and metals, for irrigating arid lands and for working up of the raw materials of the farm.

Cheap power, the dream of man since the discovery of the generation of electricity is at last within man's grasp. It can be carried directly to the source of raw materials and thereby bring about the decentralization of industry.

IT is not being too prophetic to say that the Madaras Rotor Power Plant, by making available an untapped and inexhaustible source of power, may lead us into a pioneering age more far-reaching in its benefits to mankind than can now be comprehended.

The MADARAS ROTOR POWER PLANT *and its application*

Q. *What is a Rotor Power Plant?*

A. A new engineering development which extracts power from the internal energy of the wind, thereby generating electricity.

Q. *How does it extract this power?*

A. By means of a series of huge spinning cylinders on cars that move around a large circular track.

Q. *Why are not wind mills used instead of rotating cylinders?*

A. Wind mills utilize the kinetic energy of the wind, whereas the rotating cylinders make available a large amount of additional energy from the atmospheric pressure.

Q. *How much greater is the energy developed by the rotating cylinders than by a wind mill of equal sail area?*

A. About ten times.

Q. *How is this additional energy developed?*

A. It is developed on the cylinders in accordance with Bernoulli's Theorem.

Q. *What is Bernoulli's Theorem?*

A. At any point of the tube of flow the hydrostatic pressure diminishes as the velocity increases in proportion to the square of velocity. Thus in the case of a rotating cylinder, there is a decrease of pressure on the side in which the motion of cylinder coincides with the direction of the wind due to an increase of velocity on this side. Upon Bernoulli's Theorem is built the whole science of hydraulics and aerodynamics.

Q. *Why use spinning cylinders instead of stationary cylinders?*

A. Because the total air pressure on a spinning cylinder may be as much as fifty times greater than on the same cylinder at rest. (See Fig. 1 and Fig. 2.)

Q. *Why does the air pressure increase?*

A. The spinning cylinder increases the velocity of the air current on one side and therefore the pressure against this side of the cylinder is decreased. (See Fig. 3.)

Q. *By how much?*

A. It depends upon the speed of the rotation of the cylinder. The greater the speed of rotation, the greater the pressure difference. When the speed of rotation of a large cylinder is four times the velocity of the wind, the pressure is increased about fifty times the wind pressure on a stationary cylinder.

Q. *Who first determined this difference in pressure on opposite sides of a rotating cylinder?*

A. Magnus, a German Physicist, who published his findings about 1852. This difference in pressure is therefore known as the "Magnus Effect." It is really only a special case of Bernoulli's Theorem. However, the Magnus Effect has been known by such scientists as Leonardi da Vinci and Newton.

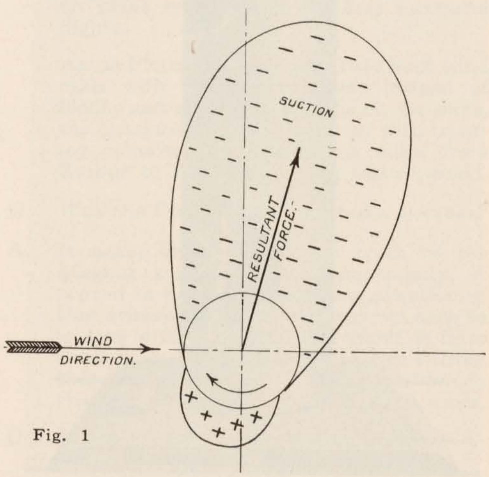
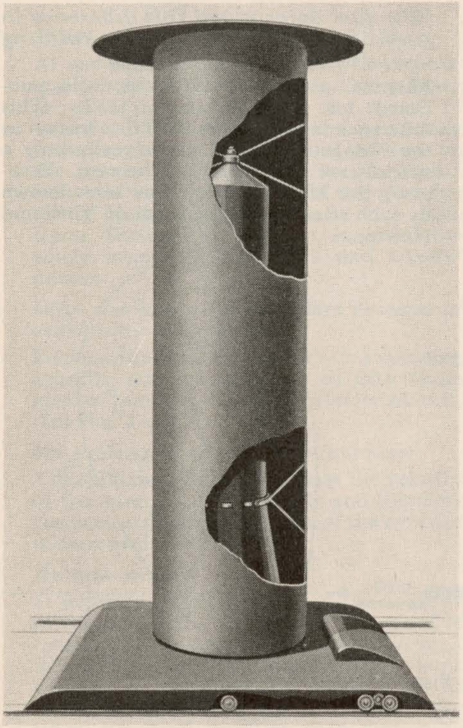


Fig. 1

Pressure distribution around a rotating cylinder in a wind stream



SECTIONAL VIEW OF A ROTOR UNIT

Q. Where in every day life may one observe this principle operating?

A. In the curving flight of a spinning base ball or golf ball.

Q. What attempts at practical application of this principle have been made?

A. The American Navy experimented with rotating cylinders in place of wings on an air plane shortly after the first successful flights.

Anton Flettner in 1923 and 1924 built wind mills with rotating cylinders instead of blades and also replaced sails on his ships, the *Buckau* and the *Barbara,* with rotating cylinders. The *Buckau* sailed from Europe to America in 1926 and returned.

Q. Was the Flettner Rotor Ship a success?

A. It again demonstrated the truth of the Magnus principle, but commercially, it proved to be an impractical application of that principle. The device was not such as to give sufficient speed to remove it from the sailing ship class and thus free it from the many economic handicaps which characterize sailing ships in modern times.

Q. Is the Rotor Power Plant an application of the Magnus Principle?

A. It is.

Q. Who conceived the idea of applying this principle to the generation of electricity?

A. Julius Madaras, an engineer of Hungarian origin, the patentee of the Rotor Power Plant.

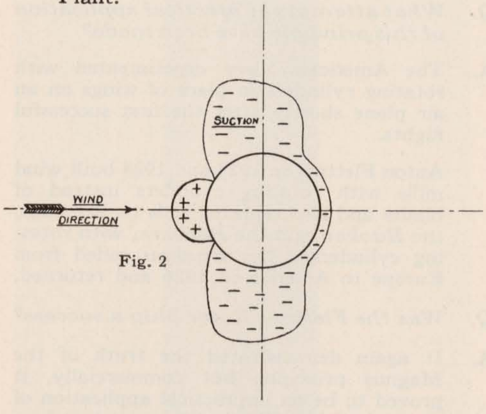


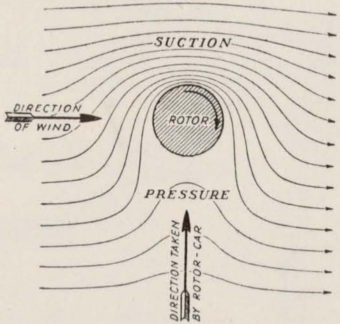
Fig. 2

Pressure distribution around the same cylinder as in Fig. 1, but with the cylinder not rotating

Q. When did he first begin experimenting with the idea?

A. In 1912, as a boy of seventeen he built a rotating cylinder on a car in the steeple of a church in Hungary which, because of its construction served as an excellent wind tunnel. Here he proved to his own satisfaction that the principle had a practical application in propelling a car. Though he conceived and planned the Plant in principle at that time, the World War intervened and it was not until 1921, after he had come to the United States, that he began really working on the project. For twelve years he has continued his work in the development and design of a plant.

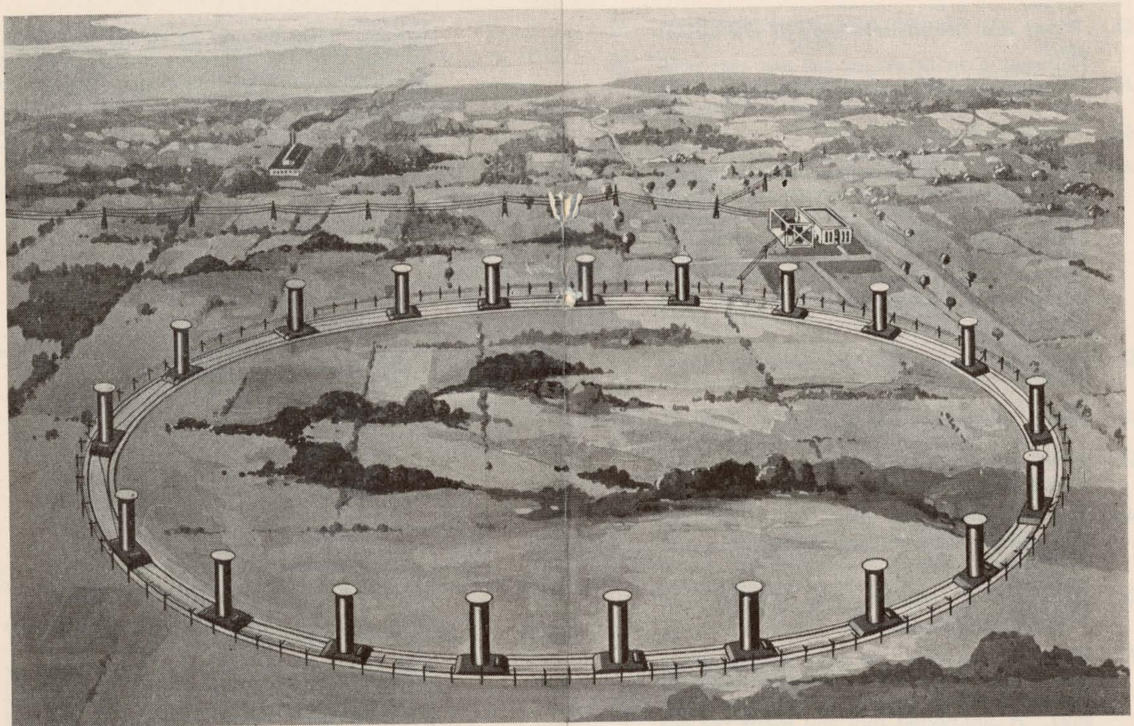
Fig. 3



Streamline flow around a rotating cylinder

Q. How far has the development of such a plant progressed?

A. One full-sized cylinder has been built at Burlington, New Jersey, and it is being tested. (See Page 4.) After the test has been completed, a rotor plant will be built. (See Pages 16-17.)



ROTOR POWER PLANT

Q. *What are the dimensions of the cylinder?*

A. 90 feet high and 22.2 feet in diameter.

Q. *How is it built?*

A. A thin shell of duraluminum is built around a fabricated steel tower so that the cylinder will turn freely. Over the top of the cylinder is a cap extending six feet beyond the edges of the cylinder to prevent a large loss of power which would result if the air were permitted to flow up and over the top. (See Page 12.)

Q. *What air force will the cylinder withstand?*

A. About 100,000 pounds side force.

Q. *What will keep the cylinder from falling over under such pressure?*

A. The car, which will weigh about 150 tons and will have a wheelbase 40 feet long and 30 feet wide.

Q. *At what minimum wind velocity will the car start to move?*

A. Four miles an hour. In spite of its immense size and weight the car will move easily on the track as it is equipped with roller bearings. A 300-pound pull will move the car on the track.

Q. *How fast do the cars travel?*

A. The cars are set to travel at a constant speed of 20 miles an hour, no matter what the speed of the wind.

Q. *How many units are there in a practical plant?*

A. Fifteen or twenty rotor units in a plant would be practical, however, about fifty rotors would work more efficiently. At places where the wind conditions are good and there is need for power, even two or three hundred rotors could be used in one plant.

Q. *Why is the track circular?*

A. In order that the plant may work equally well with any wind direction.

Q. *Can the plant be built on an elongated track?*

A. Yes. Probably most of the plants will be built on elongated tracks. At places where there is a prevailing wind, the plant on an elongated track will be much more efficient and will require less land.

Q. *How large is the track?*

A. That depends upon the number of rotors used. Forty rotors will require a track one-half mile in diameter or one and a half miles long. The distance between two adjacent rotors must be about ten times the diameter of a cylinder; that is, about 250 feet, to prevent interference.

Q. *How much land will the rotor plant occupy?*

A. Less than one acre per one hundred kilowatts. A fifty thousand kilowatt rotor plant occupies 300 acres.

Q. *Is this costly?*

A. No. The rotor plant can be built mostly on cheap land away from cities. The land will cost from $1 to $2 per K.W. which is not more than the cost of land for steam plants. In many cases, right of way for the track can be obtained, and the land inside the track can be used for farming.

Q. *Is the maintenance of the track expensive?*

A. The tracks are laid solidly in concrete, and will require negligible maintenance.

Q. *How many men operate the rotor plant?*

A. Six men in three shifts will be sufficient. The whole plant will start, stop and operate automatically. The men will be needed for supervision and watching only.

Q. *How will the plant be repaired?*

A. There will be a spare rotor unit to each plant which can be inserted in place of the unit that needs repair. Thus the plant will be kept in working order all of the time.

Q. *How does the rotor generate electricity?*

A. On each car a generator is placed and geared to the wheels. When the cylinder pushes the car around the track the wheels drive the generator, just as when an interurban or street car runs downhill, its motor acts as a generator and feeds power back into the line.

Q. *Does the spinning cylinder turn the generator?*

A. No. The cylinder is not connected to the generator.

Q. *What makes the cylinder spin?*

A. It has to be turned by some mechanical means for instance, by a motor. In the rotor power plant each cylinder will be geared to a traction wheel running on the track.

Q. *Why cannot the wind turn the cylinder?*

A. The cylinder is round and smooth.

Q. Why not put fans on the cylinder so that they may catch the wind and make the cylinder rotate and drive the car?

A. One could do so but in that case the cylinder would act as a windmill and the power developed would be reduced to a small fraction.

Q. Do the cylinders always spin in the same direction?

A. No. They have to reverse the direction of rotation twice on each complete run on the track, in order to reverse the force.

Q. Does this reversal of rotation introduce difficulties?

A. Not as much as one might expect. The cylinders are reversed automatically by a windvane, regardless of how the wind shifts.

Q. Where do the cylinders reverse the spinning?

A. Always when they travel exactly parallel to the wind; that is, where they go with the wind or against the wind.

Q. Does this reversal of rotation entail a great loss of power?

A. No. The cylinders are light. In addition, a part of the power is recaptured when the cylinder decelerates. The loss of power is negligible.

Q. How does the wind force vary on the cylinders on different parts of the track?

A. It varies continuously. However, all the cars are connected with cables and they pull each other, so that the load is equally distributed on all the generators.

Q. Why have a generator on each car?

A. It is not necessary to have as many generators as rotors. In fact, one could have a larger generator on every third or fourth car, but it is more practical to place a generator on each car.

Q. Why is it more practical?

A. The weight of the car provides the friction for the wheel on the track to drive the generator. If bigger generators were used additional weight would be necessary and there would be but small difference in the cost of generators per kilowatt capacity. Each rotor is a complete unit in itself and is more practical to build and maintain.

Q. Will the wheels slip on the rails and cause the generators to slip?

A. They will not. The weight of the car will prevent them from slipping and will provide ample traction for the generators.

Q. Will not the flange friction of the wheels cause loss and wear off the flanges?

A. No. Idlers run against the side of the rail and completely eliminate the flange friction.

Q. How much power will each rotor generate?

A. Each car will carry a 1000 K.W. generator; consequently a rotor plant with fifty rotors will have 50,000 K.W. capacity.

Q. Will the plant generate direct current or alternating current?

A. It will generate either, according to the type of generator installed.

Q. How is the power taken off the generators?

A. By a trolley line which runs parallel to the track and is connected with the transmission line through a step-up transformer and a substation.

Q. What will be the voltage generated?

A. 4400 volts will be a practical voltage.

Q. How will the voltage be regulated?

A. Induction generators will be used, which, in a power system, will always run at the same frequency as that of the power system.

Q. Will the induction generators affect the power factor of the system?

A. They will, but at the substation a synchronous condenser will be used to correct the power factor.

Q. Will the voltage be the same at any wind speed?

A. Yes. The whole plant will have constant voltage.

Q. What will vary with the varying wind?

A. The current and thereby the power will vary, but the voltage will remain constant.

Q. How will the power vary with the wind?

A. The power output will increase with the increase in windspeed until it reaches the capacity of the generator; any increase in wind speed beyond that point will not affect the power output. The plant can be designed so that it will reach full load at 15, 20 or 25 miles per hour.

Q. What wind speed will warrant the operation of the plant?

A. A wind speed of six or seven miles per hour will generate sufficient power to justify the operation of the plant.

Q. Is such a wind speed frequent?

A. At many places a wind speed of six miles per hour is maintained for 85% of the time.

Q. How much power will the plant develop yearly?

A. At favorable places the plant may develop as much power as if it were operating at full load over 50% of the time. That is it will operate at over 50% annual load factor.

Q. *How does this compare with hydro-electric plants and steam plants?*

A. Many hydro plants develop as much power as if they were operating at full load about 30% of the time; steam plants about 40% of the time.

Q. *What happens when the wind does not blow?*

A. The plant will not operate.

Q. *Is not this a serious draw back for the rotor plant?*

A. Not as great as it would seem on first consideration.

Q. *Why not?*

A. There are many places where the wind blows all of the time. In other places, the plants may be strategically located as to wind conditions so that there will be enough dependable power to supply the prime power need such as, lighting, etc. The necessary reserve can be supplied economically by supplementary plants, either hydro-electric or steam.

Q. *Where are the most favorable wind conditions in the United States?*

A. Almost anywhere west of the Mississippi, in the region of the Great Lakes or mountains, along the coasts of both oceans; where ever topography of the land is such that it will favor air currents.

Q. *What is the cost of power generated by the rotor power plant?*

A. It may range from 1 to 2 mills per K.W. hour, depending upon the locality and the wind conditions. About 1.5 mills per K.W. hour may be taken as average.

Q. *How does this compare with the power generated by other types of plants?*

A. In 1929 the national average cost of power generated by both steam and hydro-electric plants was about 7.5 mills per K.W. hour or about five times the cost of the power generated by the rotor plant.

Q. *What is included in these figures?*

A. All capital charges, such as interest and depreciation, as well as the cost of operation and maintenance. The cost of the power from the rotor plant also includes the sub-station.

Q. *Is the cost of power of hydro plants less than that of steam plants?*

A. It depends upon the section of the country and the cost of coal. The average cost is about the same.

Q. *What does it cost to build each type of plant of the same capacity?*

A. A 50,000 K.W. plant of the rotor type is estimated to cost approximately $2,000,000; one of the hydro-electric types $8,000,000—

$12,000,000 and a steam plant $6,000,000. In other words, the rotor plant, including a substation, may cost $35 to $45 per K.W.; the hydro plant from $150 to $250 per K.W.; and the steam plant may cost $100 to $130 per K.W. That is, the rotor plant may cost about one-fifth as much as the hydro plant and one-third as much as the steam plant.

Q. *Will the Madaras Rotor Power Plant fill any great economic need?*

A. Yes, it will reduce the cost of power generation. Reduced cost of power generation is one of the greatest problems of the present economic life and when that problem is solved it will aid in the return of prosperity by opening up new fields of use for electricity. If the cost of electric power can be reduced sufficiently, the market and the uses to which it can be put can be expanded indefinitely.

Q. *Could the present means of power generation, that is the steam plants and hydro-electric plants, reduce the cost sufficiently to fulfill the same task?*

A. No, they cannot.

Q. *Why not?*

A. In order to open up new fields for the use of electricity in great quantities, it is necessary to reduce the cost of power generation

substantially below the cost of fuel and capital charges alone which is economically impossible with the present means of power generation.

Q. *Why is this impossible?*

A. Because in a steam plant besides the large capital investment the coal is burned and the electricity is generated at a loss of more than 50% of heat energy. Consequently the cost of electric power generation even in the most efficient steam plant is necessarily too great for opening up new fields.

Q. *Is the same true in hydro-electric plants?*

A. It is. The average cost of hydro-electric power is about the same as the steam power due to the large capital investment involved.

Q. *Will the rotor plant reduce the cost of power generation sufficiently for opening up new markets?*

A. It will. The net cost of power generation will be cheaper than the cost of coal alone so that it will be possible to use electricity in form of heat energy. When that is done, the electro-chemical and metallurgical industries such as those engaged in making steel, copper, aluminum, nickel, zinc, magnesium, carbide, nitrates, paper, etc., will find it possible to produce more economically; homes may be heated and air-conditioned economically; agriculture will benefit through cheap electrical power for working up raw materials on the farm, as well as for supplying cheap power for machinery and irrigation; railroads will find it possible to electrify their lines at a greatly reduced cost. Such cheap power will aid in carrying the manufacturing processes to the source of the raw materials and aid in the decentralization of industries.

Q. *What other fields of business will this affect?*

A. Cheap power will not only play a part in developing and expanding its own field throughout the world, but also other similar fields of business and industry through the development and sale of devices, plants, furnaces, industrial methods, etc. Indeed, cheap power generation will create a new economic era.

Q. *How will the steel industry be affected, for instance, by the use of the rotor plant?*

A. It takes over $2 worth of coke to make a ton of steel even at places where the coke is the cheapest and 600 K.W. hours electricity will make a ton of electric steel.

This amount of power with the use of the rotor plant could be sold for about $1 at the very source of the iron ore. Besides, electric steel is much more valuable than ordinary steel.

Q. *Will it be economical to use the rotor for home heating and air conditioning?*

A. Yes, it will be. This is probably the greatest industrial possibility of the future for it takes from fifty to one hundred times as much electricity to heat and air-condition a home as the same home uses at present for lighting and all other purposes.

Q. *How does the cost of this compare with oil and coal?*

A. The rotor power plant should bring the cost of electric heating below the cost of oil heating and near to the cost of heating by coal.

Q. *Could home heating and air conditioning depend entirely on the wind?*

A. Yes it could. In super-heated water enough heat reserve could be stored for a whole week or for any desired length of time.

Q. *Who owns the basic patents of the rotor power plant?*

A. The Madaras Rotor Power Corporation, which is incorporated in the State of Michigan.

Q. Is there an operating model of the Rotor Power Plant?

A. Yes. It is exhibited at the Century of Progress Exhibition at Chicago in the Hall of Science on the Mezzanine, occupied by the Army and Navy Exhibits as an illustration of one of the basic sciences.

Q. Where can further information be obtained concerning the Rotor Power Plant?

A. From the Madaras Rotor Power Corporation, 2146 Penobscot Building, Detroit, Michigan.

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