Journal of The Gujarat Research Society
ISSN: 0374-8588
Volume 21 Issue 10, October 2019

Prevention of the Collision of the Trains Using the Magnetic Repulsion

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Abstract

For the transportation there are lot of transportation systems available. One of these old, reliable and connecting the whole India, affordable system is train transportation system. Every one passengers, army, material, courier and a lot of other services are provided with the use of trains. Although special tracks have been provided for the train to move but even then the collision of the trains took place. To prevent the collision of the trains, the brakes can be applied but there is limit for the application of brakes and to stop the trains. So, there is requirement of such an accident prevention system so that the head on collision can be prevented. In this research paper such a prevention system has been proposed which is based on the phenomenon of magnetic repulsion. For that a big size magnet have been fixed on the front side of the engines which is almost the length and width of the front side of the engine. This can be an electromagnet or a permanent magnet which depends upon the requirement of the magnetic field. This research will certainly help in the prevention of the collision of the trains and thus can save a lot of lives and the material loss.

Keyword: *Collision, Engine, Transportation, force, Magnet, Repulsion, Track, Train.*

I. INTRODUCTION

Permanent magnets provide a good and a very strong static magnetic field but sometimes the magnetic field strength still remains weak and we cannot control the amount of the magnetic flux which is present [1]. Thus we need a stronger and more controllable magnetic field, there arises the need to use the electricity. For that coils of wire are wrapped or wound around a soft magnetic material such as an iron core to produce a very strong electromagnet that can be used in many different types of electrical applications. In such a way there establishes a relationship between the electricity and the magnetism that gives us another form of magnetism which is known as the Electromagnetism. Electromagnetism produces whenever an electric current passes through a

simple conductor such as piece of wire or some cable and when the current passes along the whole length of the conductor then a magnetic field is build up along the length of the conductor. Even the small magnetic field build up around the conductor has a definite direction having “North” and “South” poles and the creation of these particular poles depends upon the direction of flow of the electric current. Thus there exists a relationship between the current flowing the conductor and the magnetic field build up around the conductor due the flow of electric current and this also defines the relationship between the electricity and Magnetism in the form of electromagnetism [2]. The circular electromagnetic field produced around the conductor due to the flow of the electric current in it has the magnetic lines of flux which forms a complete loop that do not cross round the complete length of the conductor.

The direction of rotation of this magnetic field is governed by the direction of the current flowing through the conductor with the magnetic lines varying in their strength from near to the center of the conductor with the maximum strength at the center of the conductor [3]. As the distance of the flux lines increases from the conductor the weaker the magnetic fields lines are. A simple way to determine the direction of the magnetic field around the conductor is to consider screwing an ordinary wood screw into a sheet of paper. As the screw moves into the paper the rotational action is clockwise. Similarly, the removing the screw is in the anticlockwise direction. Thus the screwing in and out of the screw indicates the direction of the current in the conductor. This is known as the Right Hand Screw Action.

A magnetic field is always represented by two poles, a north and a south pole. The polarity of a current carrying conductor can be established by marking the capital letters S and N. Similarly, “Left Hand Rule”, can be used to determine the direction of current flow and the direction of the magnetic flux around the conductor. The direction of the magnetic field is indicated from its north to its south pole. This direction can be deduced by holding the current carrying conductor in your left hand with the thumb extended pointing in the direction of the electron flow from negative to positive [4]. The position of the fingers laid across and around the conductor will now be pointing in the direction of the generated magnetic lines of force as shown. If the direction of the electron flowing through the conductor is reversed, the left hand will need to be placed onto the other side of the conductor with the thumb pointing in the new direction of the electron current flow. Also as the current is reversed the direction of the magnetic field produced around the conductor will also be reversed because as we have said previously, the direction of the magnetic field depends upon the direction of current flow. This “Left Hand Rule” can also be used to determine the magnetic direction of the poles in an electromagnetic coil. This time, the fingers point in the direction of the electron flow from negative to positive while the extended thumb indicating the direction of the north pole. There is a variation on this rule called the “right hand rule” which is based on so-called conventional current flow, (positive to negative). Consider when a single straight piece of wire is bent into the form of a single loop as shown below. Although the electric current is flowing in the same direction through the whole length of the wire conductor, it will be flowing in opposite directions through the paper. This is because the current leaves the paper on one side and enters

the paper on the other therefore a clockwise field and an anticlockwise field are produced next to each other across the sheet of paper. The resulting space between these two conductors becomes an "intensified" magnetic field with the lines of force spreading out in such a way that they assume the form of a bar magnet generating a distinctive north and south pole at the point of intersection.

II. ELECTROMAGNETISM AROUND A LOOP

he current flowing through the two parallel conductors of the loop are in opposite directions as the current through the loop exits the left hand side and returns on the right hand side. This results in the magnetic field around each conductor inside the loop being in the "SAME" direction to each other. The resulting lines of force generated by the current flowing through the loop oppose each other in the space between the two conductors where the two like poles meet thereby deforming the lines of force around each conductor. However, the distortion of the magnetic flux in between the two conductors results in an intensity of the magnetic field at the middle junction were the lines of force become closer together. The resulting interaction between the two like fields produces a mechanical force between the two conductors as they try to repel away from each other. In an electrical machine this repelling of these two magnetic fields produces motion. However, as the conductors cannot move, the two magnetic fields therefore help each other by generating a north and a south pole along this line of interaction. This results in the magnetic field being strongest in the middle between the two conductors. The intensity of the magnetic field around the conductor is proportional to the distance from the conductor and by the amount of current flowing through the magnetic field generated around a straight length of current-carrying wire is very weak even with a high current passing through it [5]. However, if several loops of the wire are wound together along the same axis producing a coil of wire, the resultant magnetic field will become even more concentrated and stronger than that of just a single loop. This produces an electromagnetic coil more commonly called a Solenoid. Then every length of wire has the effect of electromagnetism around itself when an electrical current flows through it. The direction of the magnetic field being dependent upon the direction of the flow of current. We can increase the strength of the generated magnetic field by forming the length of wire into a coil

III. LITERATURE REVIEW

Seema Chouhan in her research paper proposed a solution to avoid the collision of the trains on the same track. It has been done with the help of a proteus software which helps to make route maps and directions for the railways[6]. It also ultrasonic or DSLR which is Digital Single Lens Reflex sensor to identify the collision points and mark them important as the error cases and send this report to the control room. The advancement of this research has been proposed in this current research paper that is in case the backend system fails to report the problem to the control room or the control room cannot take the appropriate action and trains are in front of each other to collide then there is nothing that can prevent that can prevent the collision. In that case this research will

really help to prevent the Collison or minimize the loss occurring from the collision in the worst case [7]. K.Govindaraju, F.Parvez Ahmed, S.Thulasi Ram, T.Devika in their research paper proposed an information based system for the trains to a station node so that collision can be prevented between the trains [8]. It has been proposed that whenever a train is routed to or takes a wrong track then with the help of IR sensor, microcontroller, LCD display, dc motors, zigbee transmitter and the receivers the information is send to the station node which can stop that train immediately and route it to the right track and also informs the other train coming in the same route to avoid the collision. Sahiba Fatima, Vijay Nath in their research paper proposed a method for avoiding the train collision by tracking the track of the train with the help of the IOT based sensors. Using the IOT installed sensors the track will be scanned and green signal will be sent to the nearby substations, driver and the central railway monitoring office. Thus the driver of the train will be aware about the track position and take decision to move ahead or to stop the train. So, it is a nice methodology which can work well. The current research paper provides an enhancement of the research till date in case of collision of trains is going to happen and chances are very less to avoid the collision then this technology can work out[9].

IV. METHODOLOGY

As the trains moves on the rail laid in tracks specially for the trains. But sometimes due to traffic over the rails or time mismatch or wrong schedule or any of the reasons, collision of trains happens which leads to the heavy loss of lives and the material. To prevent this collision, in this research paper, magnetic repulsion has been used. For the use of magnetic repulsion, magnets are installed on the front side of the engines with the same pole because like poles of a magnet repel each other. Now the force of repulsion come into effect when the trains are near to each other that is they are about to collide. This force of repulsion produced by the magnets depends upon the magnetic field produced by the magnets. Generally, electromagnets are more powerful than the permanent magnets. But the calculations have been done.

A. Data Collection & Analysis:-

Calculation of the force and the K.E. or simply the energy required to prevent the collision of the engines [7].

For the Engine:

Length : 17.12 m (56 feet 2 in) = 112.75 inches

Width : 02.864 m (09 feet 4 ¾ in) = 678 inches

Height : 04.185 m (13 feet 8 ¾ in)

Loco weight : 112, 800 kg = 248, 700 lb.

1 m= 39.3701 inches; 1 lbf = 4.44822 N

As the magnets size will be as the length and width of the engine because magnets are mounted on the front side of the engine but we assumed that the thickness of the magnet will be 6 inches (Figure 1). So, the magnetic repulsion force is:

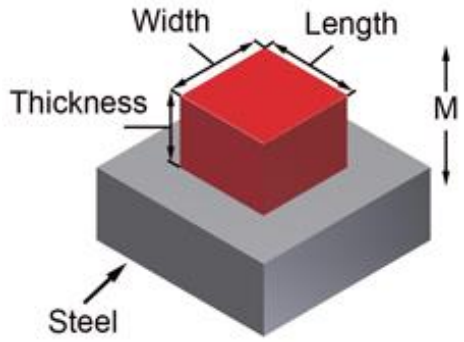

Fig. 1 Design of Magnet

Magnet Material: Neodymium (NdFeB)

Magnet Grade: 32MGOe (2-17) [Br 11, 200 Gauss]

F_{mag} = 29667.45 lbf

= 62375.209 N

For Bogies:

Weight of one bogie: 65, 000 kg;

For 10 bogies: Mass = 65k*10 = 650K

So, total mass of the engine and bogie= 248700+650000=8, 98,700kg

K. E = ½ m. V^2 (suppose velocity of the train= 65kmph)

= 1898503750 J

K. E= m*a*s

Now Suppose Trains are apart with a distance of 20 m= 20000mm

20*m*a=1/2*m*65*65*25/324

a= 8.150 m/s^2.

So, Force developed by moving engines, F_{engine}= 7324474.3441 N

Figure 2 illustrate the location of the magnet.

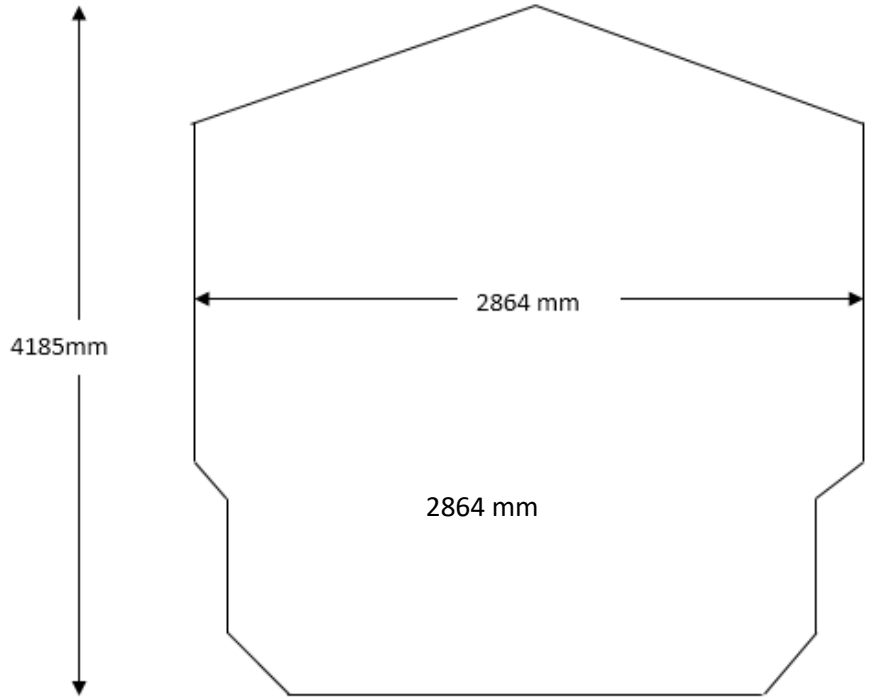

Fig. 2 Magnet attached in the front of the engine

IV. RESULTS & DISCUSSION

F_{engine} / F_{mag}=7324474.3441 / 62375.209 = ~117

So. It can be seen from the above calculation that the Fengine is 117 times more than the Fmag. So, we need stronger magnets with stronger magnetic fields to repel the engines. Some of the factors are ignored while calculating the Force like wind speed due to their negligence effect and the not a certain/fixed factor to be considered. With the repulsion between the trains, it will act like brakes preventing the collision. It may happen due to large amount of repulsion between the trains, the trains may get de-railed. But the collision leads to more destruction and loss of lives and trains also get derailed or slides over each other but all these accidents can be prevented. These calculations have been done at a velocity of train at 65kmph but when the trains move at a speed of 100 kmph then the more force of repulsion is required to prevent the collision or stronger magnets are required.

V. CONCLUSION

With the use of stronger magnets, the trains collision can be prevented and in worst possible case trains can derail but there will be no collision among the trains. This will help to save the lives of the passengers or the

persons on the board. It will also prevent the loss of material, goods etc. in transit. This is the technique of preventing the collision of the trains when nothing works out like no backend system is working, sensor system is not working and the collision is certain about to happen then this technology will really help in preventing the collision and minimizing or zeroing the loss of lives and the material or the property. When the railways will become safe to travel then this transport system will be first choice among the commutators and the revenue of the railways will certainly go up. As the railways is a government organization or department so it will increase in the economy of the nation.

VI. REFERENCES

[1] W. Magnus and W. Schoenmaker, "Introduction to Electromagnetism," Handbook of Numerical Analysis. 2005, doi: 10.1016/S1570-8659(04)13001-9.

[2] R. Carter, Electromagnetism for Electronic Engineers. 2014.

[3] E. WILD, "Classical Electromagnetism," Nature, 1955, doi: 10.1038/1761237a0.

[4] R. Feynman, "Vol 2 Ch 01 - Electromagnetism .pdf," The Mathematical Gazette. 2000.

[5] Byjus, "Electromagnetism." .

[6] Seema Chouhan, "Railway Anti-Collision System using DSLR Sensor," 2014.

[7] Mr. N. Sambamurthy*, Sk. Hasane Ahammad**, "Prevention of Train Accidents Using Wireless Sensor Networks," 2013.

[8] T. D. K.Govindaraju1, F.Parvez Ahmed2, S.Thulasi Ram3, "A NOVEL APPROACH OF TRAIN PREVENTION SYSTEM FROM COLLISION USING AVR MICROCONTROLLER," 2014.

[9] "BOGIE OPEN MILITARY NEW (BOMN) WAGON – BROAD GAUGE (1676 MM)." .

ISSN: 0374-8588
Volume 21 Issue 10, October 2019